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THREE AT BIMINI

By E. A. ANDREWS, R. P. BIGELOW, and T. H. MORGAN

PROFESSORS EMERITI: JOHNS HOPKINS UNIVERSITY (ZOOLOGY), MASSACHUSETTS INSTITUTE OF TECHNOLOGY (ZOOLOGY), AND CALIFORNIA INSTITUTE OF TECHNOLOGY (BIOLOGY), RESPECTIVELY

On the maps of the *Encyclopaedia Britannica* some very insignificant fly specks some fifty miles east of Miami, Fla., and on the west edge of the great Bahama Banks bear the name, greatly larger than themselves, "Bimini Islands." Mere points of the vast shallow Bahama Banks that here project above the sea, they form the nearest dry land (and at time of prohibition the nearest wet land) off our Atlantic coast. On North Bimini some people dwell in what is called "Alice Town" but none on South Bimini, though so close, and the big white scavenger crabs taken on the South Island are eaten as coming from a region "where people do not use."

Three students went to Bimini in 1892 to seek traces of relatives of their very remote ancestors. That they went to study marine life in such a remote corner of the world calls for a statement of the aims of zoology in the closing years of the nineteenth century. Naturalists were then eager to test the theory advanced in 1859 by Charles Darwin: that animals had gradually evolved from changes in ancestors. Natural history was becoming a real history of living animals traced back to their presumptive ancestors.

Not only did fossils suggest that some of those now extinct animals might have been like the ancestors of those now living today but embryos and young stages of some living animals led to the inference that such young might be more like the ancestor than are the adults.

In the seas more than on land phenomenal transformations are to be seen, the young becoming adults through changes that would not have been predicted. Young mollusks, worms, crustacea, echinoderms often are quite unlike their parents and must undergo a metamorphosis to become adults. In some instances it seemed probable that the young rather than the adult was like the assumed ancestor. It was said that an animal repeated its ancestral history, the young being like the remoter ancestors: An animal "climbed its ancestral tree." For instance, the barnacle sticking to rock or boat seems in its calcareous shell much like a mollusk, but it proved to be a crustacean that lies on its back and "kicks its food into its mouth," as Huxley expressed it. It was found that the young barnacle is like a water flea and after devious changes finally settles down and becomes fixed. Here the young suggested that the ancestor of barnacles was something like a water flea and nothing like a mollusk.

Vast areas of shallow seas, such as the Bahama Banks, swarm with sedentary animals, corals, sponges, sea fans, mollusks, starfish and many more, which, when young, rise near the surface of the ocean and drift about in ocean currents as swarms of minute living things of often bizarre and remarkable forms. "Plankton" was the term applied to these drifters.

Coming to this country, Louis Agassiz stimulated study of marine life, and from his seaside laboratory on Penikese Island, Mass., one of his students, W. K. Brooks, came to Baltimore in the early days of The Johns Hopkins University and, aided by contributions from citizens of Baltimore, started study of life in Chesapeake Bay.

But, though so important for its oysters and crabs, the life of the Chesapeake proved limited for solution of ocean problems, and so the work was extended to Beaufort, N. C., and later to Green Turtle Cay, off Little Abaco, Bahamas, where Brooks and his students spent the memorable summer of 1886. Here was an island that should have been surrounded by pelagic life in abundance; however, either the coral reef animals ate out all the plankton, or the prevailing currents of water and wind failed to bring plankton to the nets of the visiting naturalists.

Where was a bit of land from which to catch the floating animals of the ocean? Alexander Agassiz, the son of Louis Agassiz and a world-wide voyager, said that the Bimini Islands, on the edge of the Gulf Stream, would be a good place to try.

One afternoon in June, 1892, we loaded our baggage and apparatus with some needed furniture onto a Merchant and Miners steamer in Baltimore and started that night for Savannah, Ga. Thence by train we made a daylight trip through desolate country to Tampa, Fla. We continued on a few miles further to Port Tampa, which consisted of a trainmen's hotel and a pier extending far out into the harbor. Armed with shovels, nets, buckets, and jars of Bouin's fluid, we proceeded on our hunt for the elusive Amphioxus that we heard was to be found in Tampa Bay. One of us, at least, never had seen a living Amphioxus and was thrilled to the core at the prospect of finding this most primitive type of cordate animal in its native habitat. At length from a shovel full of wet sand a silvery, slender animal was seen to wriggle swiftly over the edge of the shovel and disappear in the sand below. More digging brought to light many specimens, a few were captured, but almost all escaped by swimming with incredible speed into wet sand before one could pounce upon them. As the tide ebbed, patches of sand became dusty under the hot sun, and one of us had the brilliant idea of throwing the wet sand onto these dry spots. That was too much for the Amphioxus. He could not penetrate dry sand, and soon our collections became so abundant that we grew reckless and threw specimens of this unique species into the capacious mouth of a tame white pelican that waddled alongside to see what we were doing and bit at our legs when we attempted to limit his consumption of his own food, our long-to-be-preserved specimens of *Branchiostoma caribaeum*.

A day or two later aboard a small steamer bound for Havana we came to Key West. Eventually we found a small sloop that could be hired and a captain who said he knew the way to Bimini. Having made our bargain, we visited markets and stores to purchase a supply of provisions to last through our projected stay of three months at Bimini. The crew consisted of the captain and owner of the boat (No. 1); another "captain" (No. 2), who came along as guest of No. 1 to help with the navigation; and a boy who served as cook, cabin boy, and crew. Captain No. 2 was described by No. 1 as a "great reader." We found out later that his reading consisted of dime novels.

With a fair wind and a smooth sea we sailed along happily within sight of the Florida Keys until late afternoon. We passed Key Largo, and the captain said it looked like rough weather and we had better seek shelter. Whereupon he turned toward shore and anchored in the lee of a small island some distance from a lighthouse to the south. After supper the wind became stronger, and another anchor was put out. Finally the drifting ceased.

The next morning we found our ship to be lying on a soft mudbank and tilted over to an angle of perhaps 30 degrees. At high tide we tried to haul the ship off the bank, but without effect. By days of hard work we took ashore everything, including the rusty mass of iron ballast, and finally she floated on a high tide. We lost no time in getting under way and sailed out into the deep blue of the Gulf Stream. We drifted swiftly to the north while headed for the Bahama Banks. Thus we sailed all day on a smooth sea with the sheets slacked well off to port while we lounged on deck, resting from our arduous labors of the previous days. But the captain took us to the wrong side of a lighthouse near Bimini, and the ship fetched up with a jerk on the Bahama Banks.

Our distress signal in the rigging brought no help from the lighthouse nor did our flares after dark. Later the lightkeeper told us he had seen our Roman candles, but could do nothing to help us. A rising tide at dawn gave courage for renewed efforts, and at extreme high water they were crowned with success. The ship undamaged was once more afloat. We got her headed toward deep water, hoisted sail, and proceeded well off shore past the lighthouse and along the coast of South Bimini until we reached the entrance to Bimini Harbor. We passed in through the narrow entrance against a swift tide and anchored near shore off Alice Town. This was June the sixteenth. When the sails had been furled and all made shipshape, we saw an approaching boat rowed by four men. Seated in the stern was an official in a beautiful white uniform. He was the Resident Magistrate acting in his capacity, seldom exercised, of customs officer but obliged, as he said later, to pay his rowers from his own pocket for each such rare occurrence. A former lawyer of Jamaica, B. W. I., representing the Queen in this small part of her domain, this coffee-colored official came over the side and at first was inclined to be very pompous and haughty, regarding with evident suspicion our leader's explanation of the purpose of our visit. But his attitude changed quickly when he saw our credentials. This impressive scroll, inscribed with our names, titles, and degrees, signed by Mr. Gilman, and sealed with the large red seal of the University, made a great impression. He at once became affable and cooperative. Our goods were admitted free, and we were asked our needs. Our first need was a house, and he pointed to one we might have beneath a grove of coconut palms. We were taken ashore, the owner of the small house was found, and he was told by the Magistrate that he was to rent it to these gentlemen. A bargain soon was made, and a week's rent paid in advance. (From that moment until our departure our landlord was seldom sober.) Meanwhile the Magistrate had hailed a small colored boy: "Hey, Johnnie, go tell your mother to come and cook for these gentlemen." She came and served us well. Also with the help of our friend, the Magistrate, we secured a small boat and a white boatman. We found North Bimini a small area, narrow and about 5 miles in length, somewhat horseshoe-shaped with South Bimini lying quite near as if in the arms of the horseshoe, leaving an entrance to the harbor between them through which the tide flowed so fiercely—about 3 miles per hour—that when anchored in it we let the towing nets drag out and had no need for the usual strenuous rowing to keep the nets full. In the incoming tide floated many minute members of the Gulf Stream fauna, and with the outgoing tide came many different creatures derived from the vast areas of coral and sea fan bottom of the great Bahama Banks. The harbor opened wide and very shallow to the east but was narrow and deep enough for small vessels to the west. There were plenty of sand flats and some lagoons with mangroves along the south island, so that animals had manifold opportunities for finding fit environments.

The Bimini Islands are almost like vessels anchored in the Gulf Stream as they lie on its edge where it is most narrow and hence most swift. The northern, inhabited island has considerable elevation, sloping from a bluff on the west down to the harbor. At the highest point the top of the bluff is perhaps 50 feet above sea level. At its base the bluff is bordered by a broad sandy beach extending a mile or more in a northerly direction from the harbor mouth. On the harbor side of the island there is a ledge of coral near the mouth of the harbor, and then a narrow beach where small boats may be hauled up. The south island is low, sandy, and barren, with low shrubby growth and coarse grass. It is bordered on the harbor side by broad, sandy shoals that are exposed at low tide. On the north island there were two settlements. The white people lived in Alice Town in a grove of coconut palms near the entrance to the harbor.

One day we asked our boatman how many white people lived at Bimini. After some thought he said, "Ninety-nine," and on second thought added, "No, if you count the magistrate and the school teacher there are a hundred and one." They all lived in Alice Town. There were perhaps 500 Negroes in

the other settlement adjoining Alice Town on the east.

The people of Bimini were a law-abiding lot in their scattered houses along the grassy road that led down to the west end cemetery, which was kept in repair by the labors of the occasional culprit who as a prisoner broke stone for the road while the constable sat watching him and then joined in the fellowship of lunch. This road had its daily uses for here the sea was bordered by mangroves standing out over the water to supply a rustic latrine where evidences of infection with large entozoa were observed.

Our laboratory was a house (Fig. 1) of two rooms and a closet, all with windows that could be closed by solid wooden shutters but were innocent of sash or glass. So we had plenty of light for using the microscope, and we worked several feet above the ground because the building was elevated on its wooden legs. One small room served as kitchen, and there the native genius with some sand and few stones, bits of charcoal and a tin can performed the skilled operations needed in making coffee and soup and preparing fish and canned goods for our hungry party of three.

Our dormitory was an old warehouse (Fig. 2) still cluttered with tackle and parts of machinery once used in a failing attempt to raise sugar cane profitably. We avoided the mosquitoes at night by keeping the wooden shutters closed till dark and then sneaking in, lighting candles, and hurriedly tumbling into our hammocks before we were detected.

FIG. 1. A HOUSE ON BIMINI USED AS LABORATORY, DINING HALL, AND KITCHEN

FIG. 2. OLD SUGAR HOUSE USED AS DORMITORY

The people of Bimini lived chiefly on and through the sea. Sailing vessels sometimes brought mail, and there were visits from the Bishop in his black piratical-looking schooner fitted with a cabin for ceremonial marriages and baptism. The vocations were chiefly three: sponging, turtling, piloting; with interspersed salvage of shipwrecks.

Sponging was conducted as follows: two men would paddle a dugout to a favorable location on the Banks near the south island where, over water many feet deep, one man with a long swaying pole armed with a fork managed to spear the little black object on the white sands of the bottom and wrest it from its firm attachment to the ocean floor. With difficulty the other man held the boat still in the current. The rippled surface would obscure objects far below till the spearer held overboard a bucket or box with glass bottom; then he would get a startlingly clear view of what was on the white sand. One by one the black, wet sponges would accumulate in the middle of the canoe. (Some that we at once thrust into strong alcohol even yet show the labyrinthine structure, the intermingling of horny skeleton and living cells that bring in food and water to the whole system of internal canals.) Having been brought home, these sponges were heaped on shore to die and later soaked in the sea to rot, protected by a net to keep them from drifting away. After that they were beaten to remove the dark flesh and reveal the brown horny skeleton, which was dried and taken to the great sponge market at Nassau to be sorted and sold. Ultimately, some appeared in our drug stores, and at that past period they were used by students in elementary schools for cleaning slates.

The hunt of the hawk-bill turtle, the source of the precious tortoise shell, was carried on mainly by Negroes on two-masted schooners that ranged far and wide for this valuable

material. Voyages were so long that little pigs, taken aboard to eat the offal, grew fat before the return home. The shells of the much larger loggerhead turtles were not valued, but their flesh was the chief supply of meat at Bimini. Poultry there was, and fish were abundant. Female loggerheads came to North Bimini to deposit their eggs on the broad sandy beach, high up near the cliff. One bright Sunday morning, it was said, a small boy, playing hooky from church, found a large female loggerhead crawling toward the cliff. His excited shouts were heard in the little Wesleyan Chapel perched above the edge of the cliff, and one by one men and boys of the congregation edged out and then rushed to the beach and joined the fray. At last the preacher too joined the party that finally overcame the turtle and once more Bimini had a taste of fresh meat. Sharks crowded to shore to get their share.

Piloting was exclusively in the hands of white men. For that purpose about half a dozen small sailboats were kept moored in the harbor close to the shore of Alice Town. Each boat was fully equipped with food, water, and a supply of "curiosities." Its sails were in stops, and its mooring could be slipped in an instant. These boats were never used for any other purpose. On the highest point of the cliff was a flagpole with a crow's nest. Here a boy was posted to watch for approaching vessels. From his perch the boy had a magnificent view over the water—golden yellow near shore, bright green farther out, and then deep blue in the Gulf Stream. His interest, however, was in detecting the first appearance of some vessel far to the north, bound south and hugging the shore to avoid the strong current. As soon as he saw a sail or the smoke of a steamer, the boy blew his horn and the fun began. All Alice Town turned out. Pilots and their crews came running past our laboratory, turning up their trouser legs as they ran. At the water's edge one man of each crew would stoop to allow his pilot to jump on his back, and with this burden start wading to the boat. The other crew men would plunge in, wade quickly to the boat, and hoist sail. The pilot on reaching the boat took the helm, his bearer went forward and slipped the mooring, and they were off. The crowd gathered at the shore to watch the start and then all rushed off to the cliff edge to get a good view of the race to the ship. It was an exciting race. The first skipper to reach the ship was taken on as pilot. His rivals and their crews swarmed aboard, nevertheless, hoping to exchange their curiosities—dried sea fans, staghorn corals, conchs, and other shells—for much needed cash. From time to time, a vessel coming by at night or in bad weather, missing the pilot, would strike a shoal and be wrecked. When we were there, the inhabitants of Bimini complained bitterly that they "had not had a good wreck in two years." To be sure, one or two coal schooners had gone ashore along their coast, but what could one do with coal? However, that wreck of two years before had been really a "good one." It was a fair-sized ship with a cargo of all kinds of merchandise. The British Government has rigid laws concerning the salvage of a wreck. A wrecking master takes charge to prevent looting and to see that the owner's rights are respected. But if a package should happen to break open, then its contents are free to all, and the Bimini wreckers know how to profit by such an accident. That wreck of two years before had been very profitable, and some of the loot was still on the market. We were offered, from time to time, various articles of clothing at tempting prices. We also heard of boxes of drygoods intended for South America containing, amidst the drygoods, concealed watches and jewelry!

We were entertained very pleasantly by the Resident Magistrate and by the Rector. The Magistrate's wife was a pretty blonde, and he obviously was very proud of the blue eyes of his engaging small children.

The Rector (or Vicar?) was of the Anglo-Catholic type and always wore a long cassock, which, in spite of its white color, looked very hot and uncomfortable. One day when we were dining with him, he asked us quite seriously whether turtle was fish or flesh. He complained that fresh meat was very scarce in Bimini and that loggerhead turtles were caught too often on a Friday. One of us assured him that turtle is fish, hoping

that this might be true for ecclesiastical purposes since the turtle is not a warm-blooded animal. Our friend had taken this missionary assignment in Bimini because of lung trouble that made the climate of England a danger to his health, and he found his solitary life here very dull—his congregation was very small and his pitiful little choir of black boys was difficult to control.

Our interest was mainly in marine invertebrates. These we collected in four principal areas. Along the small coral reef near the mouth of the harbor we used a long-handled scoop net to collect crabs, mantis shrimps, mollusks, and the like, and even dived for choice specimens under the coral reef that we could look up at through the crystal clear water. We dug for burrowing animals on the sandy shoals of the south side of the harbor. But our chief delight was in towing a fine net slowly behind the boat in the harbor, or out in the blue water of the Gulf Stream.

There were exploratory walks about the islands as when we strolled to the Negro settlement, where we got the impression that some of the Negroes were not hospitable to white visitors.

Then too we were told that we should visit the "Fountain of Youth," for was not this "Bimini"! In 1513 the king of Spain sent Juan Ponce de León to discover and settle the fabulous Bimini where the Fountain of Youth was supposed to exist. It was believed to be endowed with great powers to cure disease and to restore youth to old men. When Ponce de León discovered Florida, the King sent him again as governor of both "the island of Florida and of Bimini." Apparently, the spring was not discovered; at all events Ponce de León died in Cuba in 1521 at about the age of sixty years. We were told that the spring was on the south island of Bimini, and to it we made a pilgrimage and brought back some of its miraculous waters scooped from a hole in the lime rock that might have held a barrelful of water, not salt but fresh. Its powers—are they not attested by the fact that we three now have lived nearly 250 years already!

One day we were talking with our boatman, and he told us of the "curly-tailed lizard," which, he said, sat on its haunches like a dog and ran on its hind legs with its tail curled over its back. A few days later he took us to South Bimini and, sure enough, there under a small bush sat a curly-tailed lizard just as he had described it. We found some others, several of which were caught after a lively chase.

The research work of the triumvirate was diverse. One studied a jellyfish and mantis shrimps. This peculiar jellyfish rested quietly on the bottom of a little lagoon among the mangroves of South Bimini, upside down, not swimming about and eating fish as do other large jellyfish. Its mouth is reduced to minute openings. Some fifty of these jellyfish of different sizes and ages were found forming a retired society. Here at Bimini it was found by experiments that they cleverly captured and digested small water fleas. These jellies grew from ½ inch to be 6 inches wide and with their colors and radiated parts looked not unlike flowers lying on the muddy bottom, the males different from the females in color. It was found that the female holds the young for a while after they come through the stomach (for in jellies the eggs pass first into the stomach). When they swim free they do not look at all like jellyfish but rather like simple protozoans, as they are minute cylinders actively propelled by innumerable paddles.

The mantis shrimps, or squillas, are rather flat leggy creatures that often live in burrows. They may have strange colors. Their claws are like those of the common mantis, an insect in which the end of the limb folds back much like the closing of the blade of a pocket knife against the handle. The young may be incredibly transparent and of bizarre forms as they swim about in the drifting life of the ocean. Many of these young received names as independent creatures before it was proven that they were but the young stages of mantis shrimps. Of the five kinds of mantis shrimp we found at Bimini two were described as new, though much like some others known in distant Australia. Their young differ so much from their parents that one can be identified with the other only by experimental breeding. One day

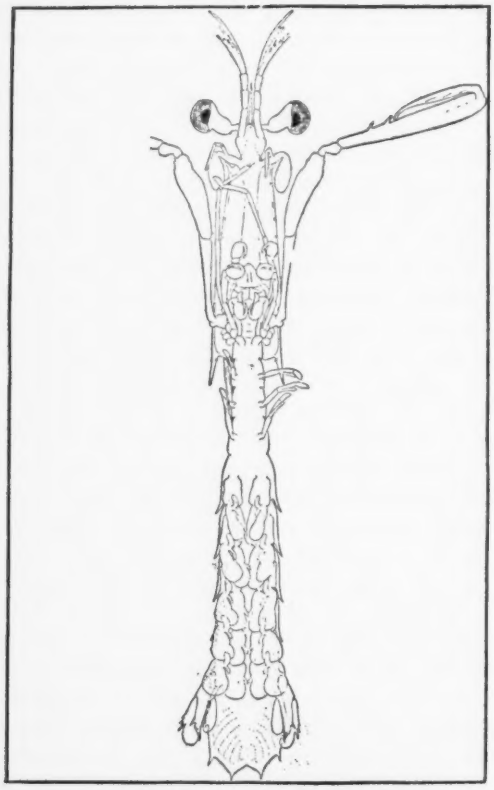


FIG. 3. LARVAL MANTIS SHRIMP
TAKEN IN A TOW NET, IT CHANGED INTO THE WIDER, SHORTER FORM OF FIGURE 4, SAME ENLARGEMENT.

we took two that were just alike, five-eighths of an inch long and apparently in the last larval stage. One of them was pickled in alcohol; the other (Fig. 3) was kept alive and nursed with loving care in sea water renewed at frequent intervals by water brought from harbor to laboratory in a bucket. One morning, to the great joy of the observer, this little animal was found to have shed its skin, and in so doing to have gained in width at the expense of one-fifth of its length. It was now in the adult form (Fig. 4) and could be identified as *Squilla quadridens* (having four teeth on its great claws), a form previously known from the coast of Florida. In addition to many beautiful but unidentified larval forms taken by the towing net on the surface of the water, we found on the bottom in shallow water many adult mantis shrimps. Two well-known species, *Gonodactylus chiragra* and *Pseudosquilla ciliata* were common on the sandflats in a foot or two of water, hiding among shells, stones, and seaweed, where their coloring, varying from mottled green and white to nearly pure green, was distinctly protective. When disturbed they moved from one shelter to another with great rapidity. At Nixies' Harbor we found a burrow in the sand where a male and a female were living happily together. They were about two inches long and beautifully colored opaque white with transverse bands, faun-colored in the male and pink in the female. This species, previously undescribed, was named after the islands, *Lysiosquilla biminiensis*. Another undescribed form was found burrowing in the coral sand of Bimini Harbor, nearly pure white; they were named from their color, *Squilla alba* (Fig. 5).

Another of the trio came to Bimini only to study the Bahama tornaria (Fig. 6), which the English naturalist Weldon had seen at Bimini. The significance of this creature is connected with the search for more knowledge of our possible ancestors. Zoologists tracing their ancestral records found difficulties in connecting the great groups together. Animals with backbones are very

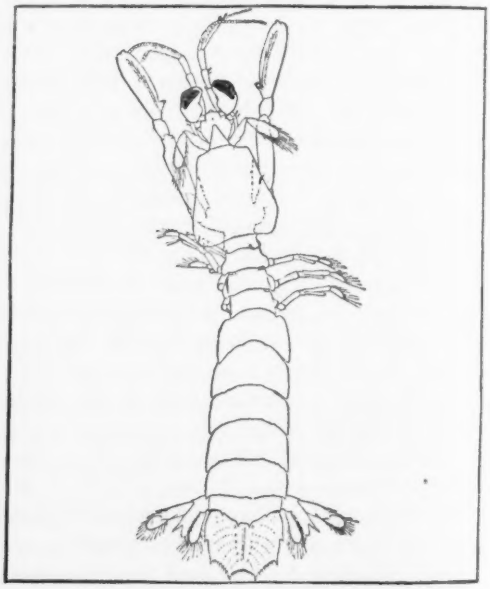


FIG. 4. ADOLESCENT MANTIS SHRIMP
Squilla quadridens, REARED FROM LARVA OF FIG. 3.

different from worms, starfish, or mollusks. How could one group derive from another? Vertebrate embryos show a characteristic and peculiar organ called the "notochord," a sort of chalk line indicating where the vertebral column will be laid down. They also show gill slits as are present in fishes. The claims of various worms were championed by certain naturalists. Among these pretenders to vertebrate relationship was the soft, slimy burrower in the sea sands, most unattractive and often protected by bromine-like odors; it was called *Balanoglossus* because the headend has the shape of an acorn (Fig. 7). There are several kinds of Balanoglossus, and some of them have young utterly unlike their parents, transparent creatures shaped like a top, long known as tornariae. Two kinds of tornariae were found at Bimini, one the big Bahama tornaria and the other as yet known only from Bimini.

One of the choicest of our finds with the towing net was a series of these beautiful animals of extraordinary size, the biggest as large as peas. From this discovery we inferred the existence in our vicinity of a very large adult, wormlike Balanoglossus. So we hunted for adults on the sand flats. There in shallow water we found holes and near them castings like those of earthworms. Our digging at first was fruitless. But finally, by moving very quietly toward a hole so as not to jar the ground and then making a sudden stab with a sharp spade, we did succeed in obtaining a few inches of a fleshy tube, as thick as one's thumb, that appeared to be the hind end of a giant Balanoglossus. That was all. Then we noticed that there were other holes with no castings. Perhaps these were the *intakes* of the burrows. Approaching these with stealthy tread, we finally succeeded in collecting several of the characteristic headends of a huge Balanoglossus. We never got a whole body. We dug them at Stokes Cay and at East Walls. We got these only at low tide, and there was evidence that the big worms put their heads up near the surface only in the afternoons and not in the mornings; we had to wait for afternoon low tides.

The third member of the trinity studied that problematical animal the lancelet, or

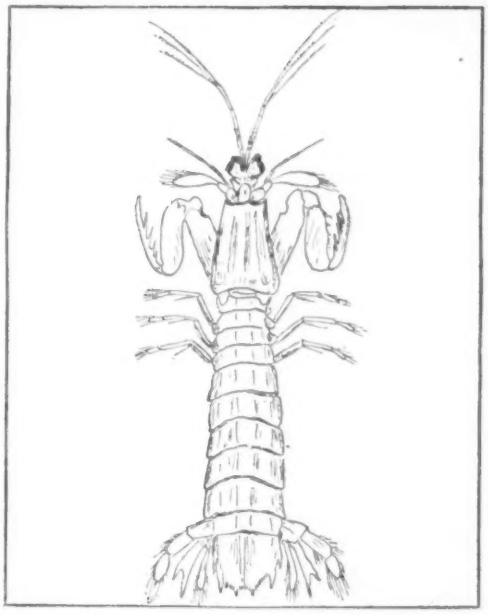


FIG. 5. *SQUILLA ALBA*
AN ADULT MANTIS SHRIMP DISCOVERED AT BIMINI.

Amphioxus, which is enough like a fish to be eaten in quantities by the Chinese. It has ample supply of branchial slits and was called *Branchiostoma* when thought to have gills in its mouth. A very muscular creature, it swims actively and burrows in the sand; but often it remains only partly buried, with mouth projecting to catch its minute food from the water. A simple, primitive creature, it suggests some of the features of a problematical vertebrate ancestor, having both notochord and gill slits. At Bimini we found them living not only in the white sand but swimming actively at night, when they were taken in the fine nets towed behind a row boat. In the laboratory they quickly buried themselves in the sand. Moreover, though entirely without eyes and with only dark specks in their spinal cords, they responded quickly to the direction in which the light struck them, going away from it. Placed in a dish with a window of the room facing east and another north, the lancelets swam from the open east window west and from the open north window south. When both windows were open the lancelets swam in a direction about southwest; that is, along the diagonal resultant of the two lights.

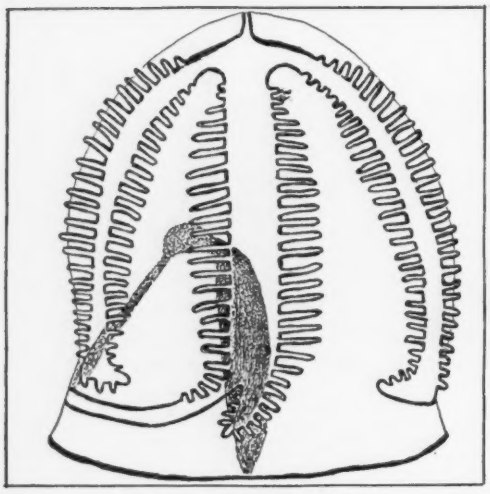


FIG. 6. A TORNARIA

THIS LARVA OF BALANOGLOSSUS CHANGED INTO THE WORM SEEN IN FIG. 7, OF THE SAME MAGNIFICATION.

All lancelets previously studied had, like vertebrates, the reproductive organs in pairs; one right, one left. But these lancelets from Bimini were not symmetrical; that is, they had the reproductive organ along only one side of the body. This we deemed of sufficient importance to make not only a new species but a new genus which we dubbed *Asymmetron* with the specific name *lucayanum*—an asymmetrical animal (Figs. 8 and 9) found in the region where the Lucayan Indians greeted Columbus and early explorers.

We arrived June 16 and hoped to stay three months—but did not.

One day there was great excitement in Alice Town; a strange sloop had anchored in the harbor. The skipper proved to be an Englishman who had been cruising in the Bahamas in search of pineapple shoots wherewith to start a plantation in Florida. Crossing the Stream, he had estimated his speed by timing chips thrown off the bow and floating to the stern of his schooner of known length. On his way home he put in at Bimini for repairs to his leaky ship, also to his eye-glasses, without which his vision was much impaired. One of us, who happened to have in his microscope case a very small screw-driver, undertook to mend the glasses, against the protest of the others who feared he would make matters worse. However, he succeeded, and the Englishman departed happy at having both glasses and ship repaired. With him as passenger went the one of us who had specialized on Balanoglossus. This was July the ninth.

The other two of us wished to remain until September. We were having a good time in Bimini. However, upon inquiry, we were told that if we stayed until September first, we should have to remain until the first of November. The hurricane season begins on August first and lasts through October. The Biminians have so great respect for hurricanes that at the beginning of the hurricane season every boat is hauled up on shore, and no one ventures out of sight of the islands. At length, we were told of a turtling schooner that would make a final trip to Nassau to sell its catch during the last week of July and would take passengers. Having packed our collections, apparatus and clothing, and

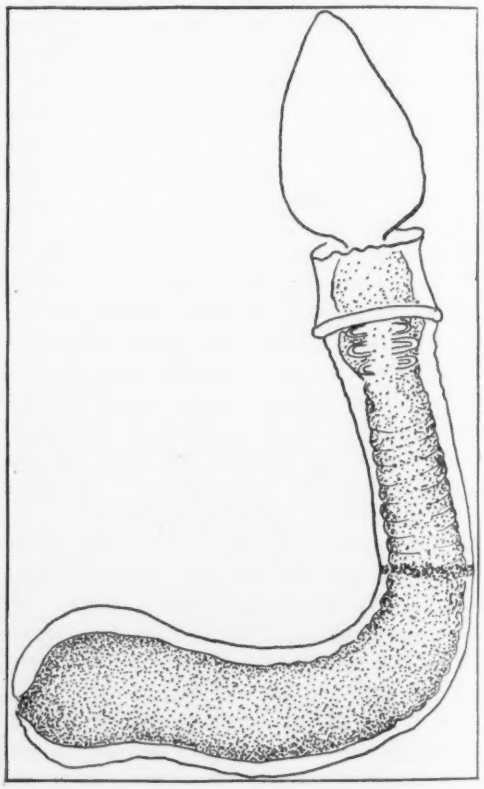


FIG. 7. MINUTE BALANOGLOSSUS

THIS WORM WAS REARED FROM A TORNARIA, FIG. 6.

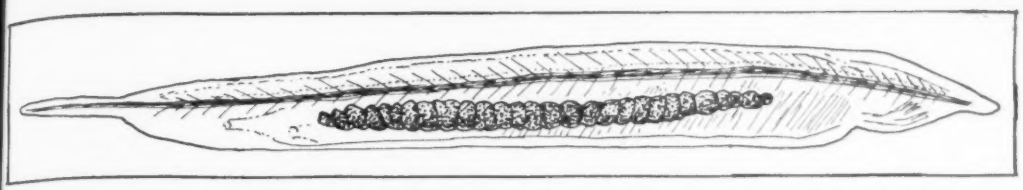


FIG. 8. THE LANCELET, *ASYMMETRON LUCAYANUM*, FOUND FIRST AT BIMINI
LOOKING AT THE ANIMAL'S RIGHT SIDE, THE DARK NOTOCHORD IS SEEN ABOVE AND THE SINGLE OVARY BELOW.

auctioned off our surplus provisions, we bade farewell to our friends in Bimini and embarked one fine morning for the voyage to Nassau. One of us did well as auctioneer, and the food we had assembled for three months was soon distributed to the eager natives—but only after paying duty on what we did not take away and also the proper fee for holding an auction in Alice Town!

We sailed from Bimini Harbor to the south until we were off Gun Cay Light, where we lay to, awaiting a boat from the lighthouse with one or two passengers for our ship. When they were aboard we got under way and sailed all day across the Bahama Banks. How the captain made this passage through an intricate mass of shoals we never knew. The noon meal was served on deck. It consisted of a bowlful of a sort of hash of rice and some kind of meat, perhaps conch, and was not bad. In the port shrouds were hung strips of conch foot from which we were invited to take a bite whenever so inclined. This meat had a sweetish taste like scallops. We supplemented this diet with our green coconuts, which furnished both food and drink. That we had these coconuts was good fortune since we were by no means well supplied with fruit in Bimini. Waiting on the shore for the boat to sail, we talked with the owner of a fine tree heavy with coconuts just between our laboratory and the shore, and he suggested that if we could pick the fruit we could have both fruit and tree. The day was hot, breath fell short, and muscles were not in practice for pole climbing, but eventually with buzzing head and thumping heart, one of us got up to the welcome leaf-stalks and rested while cutting off abundant fine nuts to drop down to the others to be loaded on board.

The evening meal was much the same. After that we were entertained by music. The captain's wife brought out a hymnbook and sang, accompanied by one of the crew with a jew's-harp or an accordion. She did not sing the words of the hymns, but pronounced the notes do, re, mi, fa, etc. Some of the others joined in. It was amusing.

The next day found us still on the Bahama Banks. The weather was fine, but the food ran low. The cook came to consult us as to what we would like to eat. There was not much choice, except more rice. Most of the passengers were on deck, talking, reading, or simply looking over the sea on watch for a landfall. The captain's wife wore dark goggles, explaining that they were all the

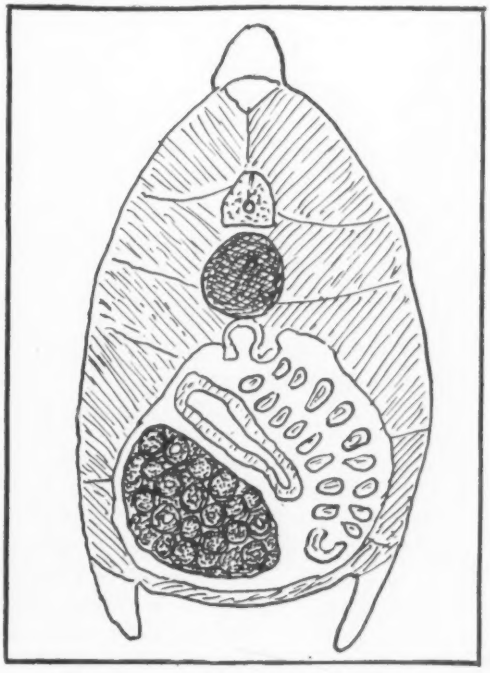


FIG. 9. A SLICE OF LANCELET
A CROSS SECTION SHOWS THE OVARY ON ONE SIDE ONLY, WITH THE NOTOCHORD ABOVE IN MUSCLE TISSUE.

fashion in Nassau. In the afternoon we sighted Andros Island to starboard and sailed out into deep water to a place where the captain believed us to be directly to leeward of Nassau. By a series of equal port and starboard tacks we reached there the next morning.

At Nassau we tied up at the sponge dock, where we parted from our shipmates and started out to explore the town. Although we were directed to the boarding house that usually took in shipwrecked mariners, we preferred the hotel.

Our first concern was passage home. We soon learned that there would be no steamer for the United States within a week or so. While waiting, we amused ourselves by sightseeing. We visited the sponge market where sponges were trimmed, sorted as to size and quality, and packed for shipment. Green turtles were there too, lying on their backs, earmarked for the English market.

We visited the sea gardens on the outer reef enclosing the harbor and there peered into the depth of a forest of waving seaweeds and corals mingled with rigid staghorn and brain corals and enlivened by the bright colors of fishes that darted in and out.

After seeing all there was to see in Nassau we made excursions into the country. A few miles out was the luminous Waterloo Pool. There at night we found a boat and were amazed by the phosphorescence stirred up by the oars. One of us stripped and plunged in; to the other in the boat he looked like an angel with four great luminous wings streaming backward from arms and legs as he swam. There fish rushed about like fiery comets. Thinking the luminosity due to bacteria, we collected a bottle of the water, but years later (1905), when the "Fire Lake" had become a two shilling evening entertainment, L. Plate, Professor in the Agricultural High School of Berlin, Germany, found in his fine nets shining dots, like the stars of heaven. Each proved to be a new sort of creature which he called *Pyrodinium bahamenense;* that is, the fiery whirler of the Bahamas. This is one of that remarkable company of peridinians that swarm the seas and often give it color by day and light by night: creatures that are plants with mouths they seem not to use, with medieval cuirass of cellulose plates, locomotor organs that make them revolve as well as advance, with active steering oar, and with thin expansions that give them bizarre forms and aid in keeping them easily afloat.

We found Bimini a most excellent place to study ocean drift from a solid island so close to the great Gulf Stream that its wonderful blue water can be seen from the shore. Opposite Bimini the Stream is only 45 miles wide, but it is about 500 fathoms deep and flows at a maximum of 4½ miles per hour. In less than one-half hour one can row into the Stream where the fauna is both varied and abundant in calm weather. There is no doubt as to the suitability of Bimini for work on surface plankton. In the few weeks the three of us were there we gained, with very simple apparatus, the material for some contributions to zoological literature, to say nothing of happy memories.

MORE AT WASHINGTON

On page 336 of the foregoing idyl, "Three at Bimini," is a pen-and-ink sketch of the workshop of Doctors Andrews, Bigelow, and Morgan during a part of the summer of 1892. They did not complain about it, though it had all modern inconveniences. They could look forward to returning to their laboratories at Johns Hopkins to complete their work for publication.

We of the A.A.A.S. are just as tolerant of our prospective shelters as were the "Rover Boys" of their shack at Bimini. But where are we going from there? Are we to beg our way from dungeon to attic, from shed to warehouse, or are we to look forward to moving into our own building—a building reflecting the importance of modern science and scientists?—ED.

ETHNIC PATTERNS IN LATIN AMERICA*

By HARRY L. SHAPIRO

CHAIRMAN, DEPARTMENT OF ANTHROPOLOGY, THE AMERICAN MUSEUM OF NATURAL HISTORY

THE countries lying to the south of us share in common a number of characteristics that are frequently evoked to distinguish them from the United States. We have been taught that they inherit a well-defined tradition originating in the Iberian Peninsula and that they use Spanish and the related Portuguese as their official medium of communication. The literature which reflects their aspirations and embodies their culture is expressed in these same cognate languages. Their emissaries and their spokesmen whom we most frequently encounter are likely to be the descendants of the Spaniards and Portuguese who conquered the countries they now represent. For these reasons, among others, we tend to speak of them collectively as Latin Americans and to endow them with a homogeneity that masks their many profound differences.

Although it would be inaccurate to deny or even to minimize the indubitable community of tradition that unites our southern neighbors, no true understanding of them can afford to overlook the diverse ways in which they deviate from one another, often to a considerable degree. One of the ways in which they differ most is in the ethnic composition of their various populations. Contrary to the fairly common belief that most Latin-American countries are predominantly Spanish or Portuguese, there are, in fact, a number of them that are largely Indian and still others whose Negro population far outweighs the European or Indian contingents. These three racial groups, Indian, European, and Negro, together with the various mixtures among them, account for almost all the population of Latin America, but their several distributions throughout the area fall into a diversified pattern brought into existence by a series of cultural, climatic, and economic causes. The remaining elements of any consequence consist of Japanese, Chinese, Javanese, and East Indians, all of whom, however, are only of local significance and together form a very small fraction of the total population of Latin America.

Anthropologists are quite agreed that man did not originate in this hemisphere and that consequently all its population, past and present, was ultimately derived from Old World sources. The settlement of Latin America, and indeed of the entire New World, was accomplished through two historically distinct migratory movements. The first of these brought to the Americas the people we call Indian. When this movement began, how long it endured, and whether it was continuous or a thing of fits and starts are questions that cannot as yet be answered with any assurance. At present there exists a majority opinion that the firstcomers began trickling in about 25,000 years ago, at the end of the last ice age. Dissenters from this view have, on the one hand, pushed back this date as much as 50,000 years and, on the other, moved it up to a mere 2,000 years ago. Even the geographic entry is no longer so certain as it seemed a few years ago when the opinion was general that Alaska was the funnel through which these migrants passed on their way to the New World. Only recently, genetic studies of the native cotton of Peru have made it necessary to reconsider the possibility of trans-Pacific movements, a hypothesis advanced on other grounds as well.

If we cannot determine whether the migration was effected as a steady stream or as a series of irruptions, it does seem clear that peoples were still continuing to move across Bering Strait well into the Christian Era. If we accept the majority opinion as to the age of man in the New World, based on archaeological and geological evidence, then the span of time during which migration was going on reaches close to 25,000 years.

The determination of this point has considerable bearing on the problem of Indian

* From a paper delivered at a Conference on Inter-American Affairs, held at the University Museum, Philadelphia, Pa., November 17, 1944.

homogeneity. We used to be told that the aboriginal inhabitants were a uniform people distributed from Tierra del Fuego to the northern reaches of North America, and capped by a thin layer of Eskimos who themselves were related to the Indians, since both Eskimo and Indians were classed as Mongoloids. If, therefore, the history of Indian migration extends over 25 millennia or more, we must, to conform with this view of Indian homogeneity, assume that all during these thousands of years a single Asiatic stock was alone furnishing the migrants who were finding their way to the New World. Not only does this make inordinate demands on our credulity in the permanence of Asiatic conditions, but it is not borne out by the internal evidence provided by the Indians themselves. For, although the various types of living Indians do not suggest extremely diverse racial origins, they demand a sufficiently distinct ancestry to account for the differences between a Sioux and a Northwest Coast Indian, and between an Indian of our eastern woodlands and a denizen of the Amazon Basin. If we are to classify them all as Mongoloid, and I think on the whole justly, we must also keep in mind that there are many varieties of Mongoloids in Asia from which the Indians may derive their heterogeneity. I make this generalization on the origin of Indian variation without intending to deny the possibility that some of it may have developed in America.

When the Spaniards and Portuguese reached the New World they found it inhabited throughout its length and breadth by the Indians. The distribution and concentration of the aborigines, however, were by no means equal. For the most part the land was only sparsely occupied, except in two regions where the population had grown to relatively large proportions. In Mexico and Central America and in the Andean Highlands of South America civilization had taken root and was supporting a dense population. Estimates for the total population of the Western Hemisphere at the time of Columbus vary considerably, some authorities suggesting as many as 50 million inhabitants and others more conservatively giving about 8 million. Whatever the actual figure may have been, all are agreed that the Inca Empire in the Andes and an area comprising central and southern Mexico, Guatemala, and Honduras contained at least half, and probably a good deal more, of the total Indian population.

This, very briefly, was the situation when the second era of immigration began in 1492. Although we are here concerned only with the consequences of this migration for the New World, it was an event of world-wide importance and to be fully appreciated must be seen as such. Of all the mass movements that have taken place in the past, none approach in magnitude of numbers or in area involved the post-Columbian migrations from Europe. The stream of people rising from Europe spread throughout the earth, but its principal course set toward the New World and has continued in this direction throughout its duration of 450 years. The Mongol invasions of the thirteenth century, although comparable in the distances traversed, were confined to a relatively small number of conquerors. Similarly, the historically significant *Völkerwanderung* of the early Christian Era shrinks to the level of a local upheaval when compared to the vast eruption of peoples that occurred between 1492 and the present day.

Not only were the post-Columbian readjustments of population on a scale hitherto unknown, but also the character of the movement and its origins were much more complex and varied than those of previous migrations. It is impossible in a limited space to do justice to the history of this migration, but some idea of its magnitude and ramification emerges when we recall that the period began in the Renaissance and reached its apogee in the modern industrial age. During much of this time revolutions in political, religious, social, and economic affairs in Europe were creating stresses and providing motivations for wholesale migrations. Moreover, the complexity of the phenomenon was greatly increased by the untold number of African natives added to this flow of humanity against their will, and by the numerous Chinese, Hindus, Japanese, and other Asiatics also drawn into the currents of population adjustment that followed on the increasing integration of the world.

So varied a movement cannot easily be

broken up into mutually exclusive categories or phases, but it is possible to discern in it two contrasting, although frequently overlapping, forces. The first and older was the conquering and exploiting aspect of European expansion. It involved, at most, relatively few men, and it began in southwestern Europe. The second factor was largely a colonizing and settling activity, which began later and finally affected an enormous number of people from all parts of the world, but especially from Europe.

The first of these aspects created the great empires and extended the political and economic control of Europe. It engulfed practically all Africa, it managed to exert control over a large part of Asia, it spread over the islands of the Pacific, and for a time at least held complete sovereignty over all the Americas. At one time or another 85 percent of the earth's surface lay in the hands of European powers.

The colonizing impulse was more restricted in its expression, finding its major resolution in the New World and in the more sparsely inhabited regions of the Old World that were suitable for European settlement.

The first Europeans to leave for the New World came from Spain and Portugal. Many of them were adventurers, but some remained to settle in these new-found lands as conquerors and landlords. Having established their primary base in the West Indies, they soon invaded the mainland, establishing their hegemony from California and what is now the southern United States to the tip of South America. All this vast region, except for Brazil, which fell to the Portuguese, became Spanish. The political control thus established had enormous consequences because it effectively sealed off the territory over which it exercised its sway from settlement by any other European power.

It is customary to contrast the Spanish and Portuguese attitude toward their colonial empire with that of the English by saying that the English set up permanent colonies and settled the family units in their American plantations, while the Spaniards and Portuguese were not colonizers but conquerors who came to the New World only to gather a fortune to take back home. Whatever truth there is in this cliché, it is not the whole truth. If we compare the English and Spanish rates of settlement we find that they were not so different as we have been led to believe. Rosseeuw St. Hilaire has estimated that during the first 150 years of the Spanish Empire in America 3 million Spaniards all told migrated to Latin America. Even if we scale this figure down, as Kuczynski believes should be done, it still remains comparable with the number of all immigrants (English, Dutch, Swedes, French, and Germans) who settled in the United States during its first 150 years. Even as late as the American Revolution the total population of the United States was only about 3 million, the large proportion of whom represented a growth by natural increase.

This showing of Spain is all the more remarkable when we recall that during the period of colonial greatness her home population had become static and already revealed evidence of exhaustion. England, on the other hand, was at the beginning of an extraordinary expansion of population and could easily spare of her excess. It is unfortunate that for this early period there are no abundant and reliable figures with which to contrast the growth of the European population in Anglo and Latin America, but we may obtain an approximation of the state of affairs by combining Kroeber's and Willcox's estimates for the century between 1650 and 1750. These indicate that while the English-speaking peoples were increasing by 1,260,000 the Spanish and Portuguese had expanded their number by 2½ million.

Although the Spaniards and Portuguese had by 1750 explored much of their empires, with the exception of the jungle interior of South America, they had elected to establish their principal settlements wherever the aboriginal population was heavily concentrated. Brazil was a notable exception to this rule, since it contained no great Indian civilization with massive populations. As a result the Portuguese remained along the coast, hardly penetrating into the heart of their vast territory. But the rich and populous centers of colonial Spain grew up in Peru and Mexico where native civilization with its attendant populations had reached their maximum growth. In Argentina, Chile, Paraguay, and Uruguay, on the con-

trary, where the Indians were few, the Spanish colonies were of lesser importance not only in wealth but also in numbers.

The coincidence of Spanish settlement with aboriginal patterns of population concentration has been attributed to a number of causes. The wealth of the Inca and Mexican Empires undoubtedly attracted many who sought the loot that the native chieftains possessed. But after the treasure had been dispersed the availability of a large population must have been effective in holding the conquerors who brought with them a tradition of a peasantry attached to a vast estate. The Indians provided the labor necessary for such a mode of life and indeed made it possible. Dr. Ruth Benedict has pointed out that it was not the size of the population specifically but the system of *corvée* labor, by which the overlord could command free service, that explains the concentration of Spaniards in these areas of ancient civilization. To these Indians living in agricultural civilizations, politically well knit, the whites merely replaced one exploiting class, with which they were already familiar, for another. The faces were different but the demands were the same. Consequently, the Indians accustomed to exploitation by native overlords accepted these conditions. The Indians who were free of such a caste system rejected the demands of the whites and were exterminated or pressed back into marginal and inhospitable territories. The absence of a large subject native population does not, however, completely explain the neglect of the southern half of South America during colonial times, since relatively large Spanish populations also settled in Colombia and Venezuela where with few exceptions the native population was scanty also. These, however, were areas that by comparison with Argentina, Chile, and Uruguay were more favorable for Spanish agricultural practices. And although it is true that the Spaniards in the Caribbean soon sought the expedient of introducing African slaves to replace the decimated Indians, those on the mainland never imported Negroes to the same degree.

It must be kept in mind that the number of Spaniards during this colonial period probably never exceeded the Indian population in any country and in most areas was much below it. As a result a mixed group of mestizos, part Spanish and part Indian, came into being, and by the end of the colonial period most of the Latin-American countries, with the exception of Brazil and the Caribbean Islands, consisted of varying proportions of Spaniards, mestizos, and Indians. It can be safely affirmed that at the beginning of the nineteenth century Latin America, with the above exceptions, had emerged from three centuries of Spanish domination as an area primarily of Indian and part Indian blood. The numbers and proportions of pure and mixed Indians varied. The number of unmixed Indians was high in Peru, Bolivia, and Guatemala, and the mestizos were relatively numerous in Colombia, Chile, Venezuela, and parts of Mexico. In absolute numbers the Indian population was most densely represented precisely in those areas where they had been most heavily concentrated in pre-Columbian times. There are, of course, exceptions to this generalization. One in particular has been cited frequently. This is the West Indies, which were more or less completely denuded of aboriginal inhabitants by the early Spaniards. The cogency, however, of this exception depends on whether we accept early or recent figures on the population of the West Indies. A sixteenth-century writer estimated a native population running into millions (and much has been made of the fact that the West Indies, once a great center of Indian population, now has fewer than any other Spanish or Portuguese settlement), but more recent authorities have scaled this figure down. Kroeber, for example, allows no more than 200,000 for the entire region in pre-Columbian times.

This balance of Indian, mestizo, and white populations might have continued down to the present time had it not been for the migration of the nineteenth century. The preceding three centuries had witnessed a very considerable movement of population from Europe to the New World. The exact number of migrants is unknown, but from indirect evidence we may estimate that hardly more than 5 million left Europe for various parts of America. Thus in one third of the time ten or eleven times as many people departed from Europe for America

as did previously. It is for this reason that the migration of the nineteenth century is known as the Great Migration. Not only in size but also in composition the nineteenth century movement differed from its predecessors. The contributors to the earlier migration had come almost exclusively from the Atlantic nations. Starting from southwestern Europe, Spain and Portugal were the first to embark on a serious program of overseas colonization. They were followed by France and soon after by England. The Dutch made an ambitious beginning but faltered, and the Swedes also attempted a settlement, an experiment which they abandoned. The sequence of these national ventures into colonization conforms roughly to the order in which the respective nations turned toward colonial empire building. It was no accident that the Atlantic fringe of Europe first became involved in these expansions overseas. The Great Migration of the nineteenth century, however, drew into its orbit peoples and nations that had previously been little concerned with this trans-Atlantic movement. Some Germans from the Rhine country had settled in Pennsylvania early in the eighteenth century, but it was not until well in the nineteenth that the vast movement of Germans to the New World began. Like a wave beginning in the west it moved across Germany eastward, drawing into itself recruits from farms and cities. The Irish famines of the 1840's started another large contingent toward America. In general, however, the sources of immigration moved eastward and southward, while the earlier reservoirs along the Atlantic became less significant. By the end of the century every nation in Europe was adding to the stream of people flowing to America. The major portion landed in the United States. From 1820 to 1935 about 35 million entered the States. It is difficult to estimate the total number that elected to try their chances in Latin America, but it must have been less than 20 million and may have been greater than 15 million. Argentina alone received over 6 million after 1857. These streams of migration, moreover, differed in composition as well as in size. The northern branch brought representatives of all the countries of Europe to the shores of the United States and to a lesser extent to Canada. The southern one, on the contrary, was fed mainly from Spain, Portugal, and Italy, with minor tributaries from Germany and Poland. But of more significance to our enquiry, the migrations of the nineteenth century did not affect all Latin America as did the earlier phase. The greater part of the southern migration went mainly to Argentina, Uruguay, and Brazil, with only minor diversions elsewhere. Here was a stretch of unexploited land thinly populated by Indians and mestizos and unsuitable for the *encomienda* system of great estates. It was, however, eminently suitable for the new migration which consisted of Europeans accustomed to work their own farms. As a result of this flood of settlers the Indians and mestizos of Argentina have been swamped and are now reduced to relative insignificance in a population that is about 98 percent of European origin. The Spanish contingent no longer exclusively represents the European strain. The Italians form approximately half the total population and in some areas are the dominant strain numerically. Similarly, Uruguay, which had remained undeveloped all through colonial times (its population as late as 1800 was little more than 30,000), became a receptor of migration. Its small population, largely mestizo, was engulfed by Spanish and Italian immigrants who were able to convert the land to agricultural and pastoral uses as world markets expanded during the nineteenth century. Thus its population today is largely of recent European origin, with the remnants of its former mestizo inhabitants relegated to a small minority.

Brazil also was one of the major depots of Latin American immigration during the nineteenth century. About 4,600,000 new immigrants have settled there, although not all have become permanent additions to the population. Italians and Portuguese constitute the great majority of them, with Spaniards, Germans, some Poles, and other Slavic people making up most of the remainder. The southern portion of Brazil, neglected by the Portuguese of colonial times, has been the seat of most of the modern settlement. By virtue of its agricultural possibilities, its cool climate, and its freedom from previous exploitation it has proved attractive to the

more recent immigrants, who now make up most of the population. The population farther north has been relatively undisturbed by the later-comers, maintaining the ethnic composition established during the colonial era.

The impact of the nineteenth-century migration from Europe has been felt also in various other countries of Latin America but to a lesser degree. Some countries, such as Peru, Bolivia, Ecuador, Paraguay, Colombia, Venezuela, and Mexico, to mention only the larger ones, have felt only lightly the influence of the newer migration. Chile, on the other hand, largely a mestizo nation with a small Spanish landowning population, has absorbed a small but significant group of new settlers. German, Scotch, and English immigrants in relatively small numbers have been added without, however, altering very profoundly the basic composition of the nation.

The third principal element in the population of Latin America is the Negro, whose major distribution is centered in the Caribbean and along the tropical coast line surrounding this sea. The presence of the Negro in this area may be traced to certain historical events and to the climatic tolerance which he possesses for warm humid regions. He first appeared in the New World in the Caribbean and in Brazil, the traditional points of entry into Latin America. In both places he was brought in to replace or to supersede the native population, whose accustomed mode of life was incompatible with the demands of the large estates set up by the Spaniards and Portuguese. In the West Indies the Spaniards, faced with an Indian population that was dwindling to the vanishing point, felt compelled to introduce African slaves to furnish the labor necessary for their plantations.

With the land divided into large holdings and the labor problem solved by a rapidly growing Negro population, the incentive for additional European recruits to settle in the West Indies in competition with wealthy landowners and slave labor was naturally absent. The typical pattern that developed during colonial days was a small landowning aristocracy mainly of Spanish origin, with an ever-increasing slave population almost entirely pure Negro. Cuba, rather exceptionally, preserved a relatively large European population, and Puerto Rico, as a result of some nineteenth-century immigration from Spain, has maintained an even balance between Negro and white. Elsewhere in the Caribbean Islands, however, the Negroes or mulattoes are the dominant population. Haiti, for example, is all Negroid. Jamaica is largely so. The smaller islands for the most part may also be classified as Negro or Negroid.

In Brazil the situation was somewhat the same. The first Portuguese settlements were made at Salvador in Bahia, where tobacco and later sugar plantations proved very remunerative and stimulated the spread of vast estates. Both at Salvador and at Recife flourishing *fazendas* created an urgent need for labor that could work under tropical conditions. The declining Indian population, never very large, was soon rapidly replaced by importations of Negroes. Mixture among all three stocks, Portuguese, Indian, and Negro, proceeded apace, but while the Indian contributors were declining in number and the Portuguese were being only slightly replenished from Europe the Negro contingent was being actively increased by large and steady importations. As a result the Negro element in much of northeastern Brazil became an important section of the population, not only as purebloods but also as an element in the hybrid populations. Not recognizing these ethnic differences officially, the censuses of Brazil give us no light on the number of Negroes and mixed Negroes in the present population. Unofficial estimates, however, place it conservatively around 20 percent of the total population. There seems little doubt that it was higher before the newer European settlers of the Great Migration poured into southern Brazil. The relative density of the Negro population increases as one goes north into the more tropical regions of the coastal belt.

At various other points along the tropical belt of South and Central America we find additional centers of Negro population. In Colombia, for example, a relatively large Negro population was introduced to work sugar plantations and is now distributed along the coastal lowlands and in the valleys where sugar cane is still grown. Ecuador

also, along its northern coastal strip, has become increasingly Negroid.

The dispersion of Negro population continues to follow the humid coast of the Caribbean into Central America, while the coast line on the Pacific side has remained largely Indian, mestizo, and European. This does not mean that Negroes are unsuited to the highlands or Pacific slopes. Rather it suggests that they are better able than the whites and Indians to adapt themselves to the humid tropical belt on the Atlantic side. For this reason we find Honduras, Nicaragua, Costa Rica, and Panama with relatively large Negro populations along their Caribbean and with few or none on their Pacific shores. El Salvador and Guatemala facing the Pacific have practically no Negro settlements.

Similar circumstances account for the large Negro populations in Surinam and British Guiana. The paucity of a native population, the tropical conditions, and the adaptability of the Negro have combined to favor his rapid increase in these regions.

I have thus far referred only in passing to other elements in the population of Latin America. There are a few such, but they are only of very local importance at present. For example, both the British and the Dutch have imported labor from India and Java to supply their needs in British Guiana and Surinam. As a result over 42 percent of the population of British Guiana and about 24 percent of Surinam is listed as East Indian, with 19 percent of Surinam of Javanese origin. The Japanese in the present century have made a slight contribution to the migration to Latin America. Most of the settlers of this origin have gone to Brazil, where about 175,000 were reported in 1934 with a smaller group of 21,000 established in Peru.

It is, I believe, evident from this summary description of a highly complex history that Latin America is far from homogeneous in her population. Not only do individual countries differ profoundly in their ethnic composition, but within each of them the diverse elements are by no means evenly distributed. To say, for example, that Peru is 46 percent pure Indian is misleading, since in certain highland districts the Indian population is close to 100 percent. To estimate Brazil's Negro population as 20 percent of the total hardly does justice to the much higher percentage found in the northeastern section of the country.

Although I am fully conscious of the difficulties of drawing generalizations out of this complicated pattern of ethnic integration and recognize the danger of oversimplifying an intricate situation, I think certain tendencies are apparent in the population process of Latin America. If I list them without tedious qualifications, I do not mean to imply that they are universally valid. Nor do I intend to imply that the factors involved are simple or even positively determined. In some instances we may see historical courses at work; in others, ecological, cultural, and climatic controls determining events.

1. In general the aboriginal population, the Indians, has survived in strength in the highland regions where they formerly had centers of well-organized agricultural people. The very size of their populations, running into millions, prevented their extinction, since their numbers were great enough to withstand the decimation resulting from Spanish contact and still leave a large enough nucleus with which to rebuild their strength. Indians have survived also in the forested interiors of the Tropics. Their numbers there today are relatively small, but they always have been. Their protection lay in the isolation which the jungle provided. Wherever they have come into contact with Europeans on the margins of their territory, they were quickly wiped out.

2. The areas of Latin America where the white population, Spanish in particular, may be found today in greatest numbers and purity are those which were relatively neglected by colonial immigration. Either because of the lack of a numerous native labor supply or because the territory was unsuited for the agricultural demands of these early times much of the southern part of South America lay fallow with only a scanty population of mestizos and whites. The tide of the Great Migration of the nineteenth century inundated in particular these regions and converted them to areas of dominant white population. Typical of this transformation are Argentina, Uruguay, and southern Brazil.

3. The intermixture of Indian and white

that began soon after the Conquest has given rise to a mestizo class, intermediate often between the Indians and the aristocratic Spanish landowners. Mestizos may represent anything from a scarcely diluted Indian to a near-white. Both extremes form hazy boundaries with the races they approximate. As an element in the population they are especially significant, since only through them may homogeneity be achieved. In colonial times they formed a large proportion of the population where the Indians were few in numbers or where the whites were especially numerous. The countries falling into this classification and also escaping the nineteenth-century migration are those that at present are distinguished by their proportionately large mestizo population. We may, for example, point to Chile, Paraguay, El Salvador, and parts of Mexico.

4. The Negro contribution is chiefly concentrated around the Caribbean and in various outliers where the climate is humid and tropical. In much of this area they are overwhelmingly in the majority, not only as pure Negroes but also as Negro–white and Negro–Indian mixtures. Their distribution has to a large measure been guided by two factors: the absence of a large and flourishing native population and their adaptability as labor in a region climatically unfavorable for white people.

5. The variations in these elements in the countries of Latin America offer us a clue to understanding their cultural history and their future development. It is no accident that a remarkable renaissance in native arts and crafts flourishes in Mexico and Peru, that Brazil has evolved dance and musical forms that owe much to Africa, that Djuka art emerges in Surinam, and that Argentina is mainly European in spirit. The composition of their respective peoples with their cultural heritages explains much.

THECA

The microscope reveals a wealth of cells
In corium and epidermal shield
Devised to test, resist, or yield
Or build anew as accident compels.

The melanotic touch in coat of tan
Completing range from sickly white to black,
The size and form of hair till age shall lack,
Alone suggest the source and state of man.

No microfeature tells of highs or lows
Of beast or saint, the joyous or forlorn.
The tegument but shelters each within.
How weak in biologic wisdom those
Who tempt the wrath of millions yet unborn
And judge a man's real worth by hue of skin.

—John G. Sinclair

ON THE SOCIAL AND MORAL IMPLICATIONS OF SCIENCE

By JOSEPH SCHNEIDER
DEPARTMENT OF SOCIOLOGY, UNIVERSITY OF MINNESOTA

THE advancement of science in all its phases, supported by the appearance of the philosophical interest among men of science themselves, has established the view that the universe is neither an order nor is it moral. The diffusion of that attitude in recent years probably accounts for much of the gloom which is current concerning the place of science in the scheme of things to come, and, no doubt, for not a little of the resentment which many scientific workers show toward those who would show us where science is taking us, and how. Many a scientist is still so self-assured in his own accomplishments as scientist that it comes as a sharp jolt to him to be told that he can no longer take the values which sanction his work as in the nature of things, and, therefore, for granted; but that they are for him, as for all of us, man-made judgments about the relationship of men to one another and to the world.

Until well into the nineteenth century men believed that the world was an order, and that the discovery of this order would make men happier, better, or both. The world was conceived as a Universal Harmony, a kind of cosmic Utopia, the essential principles of which it was assumed could be empirically discovered and given theoretical formulation through mathematical reasoning. By that time Nature was no longer regarded as caring whether the secrets governing this harmony were discovered, but there was the belief that if the principles of that harmony were delineated, the threads of the good life would somehow be exposed. Evil was ignorance of the Universal Harmony. Man could banish evil through a knowledge of the objective world, cool and indifferent as that world had, since the Renaissance, come to be considered in relation to man's aspirations.

The experiences of the first half of the twentieth century—now nearly completed—have shattered what may have remained of nineteenth century scientific optimism. There are some among us who would assert that scientific knowledge has not enriched the social and moral life one iota. Without going that far, it may be confidently asserted that the simplest needs of men still remain unsatisfied. Adequate food, clothing, and shelter for everyone is still an unrealized aspiration in a world where population is shrinking relative to the improvements in techniques for getting food. In our own community we have done well enough in these respects by past standards. Not even during the depression years did hunger reach famine proportions. But the mockery of the ideal existed nevertheless. Hunger did occur, needlessly. There was the promise of abundance side by side with a paralysis of will. With plenty to eat everywhere there was an inability to obtain it.

More recently the world has been plunged into a vast contest of organized destruction. The very magnitude of the destruction is of the scientist's own making. It was he who developed the principles from which were born in the minds of the inventor and engineer the guns, the shells, the tanks, the ships, the planes, and the robot bombs which threaten to make a shambles of the world for years to come, and even destroy the laboratory itself. It was he who developed from his studies of collective behavior the techniques of mass regimentation for death everywhere so in evidence. It has not been enough for the man of science to discover that Nature is indifferent to our ideals and does not encourage them. He has done more. He has sharpened and trimmed Nature's claws, filed her fangs, trained her, and then unleashed her against all of us, including himself. And the future is even more terrifying in prospect than the present.

The recurrent protests of the scientist, each time he is challenged by things as they are, that he is the creator of a bright and

shiny new world by approximation and degrees, and not all at once, have not been received of late with kindly countenance. The present prospect is that no matter what his way of working may be, science may itself be the end of the human enterprise. The belief in social progress, of which science has nearly always been viewed as the efficient cause, has come to a low state in our time. Few people, after beholding the work of the demigod in the laboratory and the practical effects of that work outside, any longer believe that mankind is moving forward in the direction of a desirable goal. Even the hope that this might be so is rapidly waning. People are beginning to doubt the world view of science, and, what is more, science itself. Men have achieved longer life and better health, it is true. The prospect of freedom from toil and greater leisure has been before us for a long time, but for the millions it is still an aspiration. Better living for them is still a long way off. The good life for them is still obscured by the serfdom to the machine, the factory system, and antiquated systems of land tenure. Indeed, security, peace of mind, loyalty, friendship, kindliness, and the general attitudes associated with the brotherhood of man appear to be becoming less as science moves forward. Witness, for instance, the rising hate cult which has sprung up on every side. An individual who professes Christian motives is, at best, and still after two thousand years, an impractical dreamer.

The transition from primary to secondary group organization has been the achievement of science. The general result has been the creation of mass society: huge aggregations of people in close physical juxtaposition, possessed of such like-mindedness born of the anxieties and uncertainties of their lack of status as to be forever the prey of suggestion and crowd and mob behavior. The monotony of living and working by the clock and of having one's activities paced by the machine, has unbalanced men's emotions, frayed their nerves, and made them fit victims of fads, fashions, crazes, and manias. Extended and instantaneous communication, coupled with the developed techniques of opinion management, instead of drawing mankind together into a common society, have only heightened conflicts, aggravated class and race hatreds, and produced the phenomenon of leadership. The return of a dark age is not outside the limits of probability.

Altogether, the indirect management of the human enterprise by men of science has not fulfilled the promises which are imbedded in the idea of progress.

HAD the scientist stayed with his observations on falling bodies, the contents of the test tube, the structure of the mind, and generalized group behavior processes, the impact of science on daily living might not have been so great. The world of the celebrated man in the street has remained strangely untouched by the principles of science while at the same time accepting the practical benefits which follow from them. T. C. Mits knows how to use the automobile, the telephone, but he seldom understands the operating principles of either. But the general method of the scientist proved so successful in these respects that he, in the guise of anthropologist and sociologist, attempted to apply it to the study of social order and moral values also. The impact of scientific progress upon conduct would have been great in any event, but the attempt to deal with moral experience through the use of the same techniques which had proved so rewarding in other endeavors introduced a self-consciousness about behavior which only further helped to disintegrate what little orderliness might have remained.

The rewards of less ignorance about how people come by their moral values were not the discovery of an absolute moral law, a moral law of universal application. The discovery which was made was that there is not one moral law valid for all times and places but many, and all of them workable. It was discovered that people living in different places have different moral customs. It was also discovered that the same people in different times have different moral customs. Furthermore, it was inferred that one set of moral customs is as "right" as another. The fact which emerged is that what *is* is right. Parricide is as right as giving grandfather

a pension while he nurses his "misery" and increasing decrepitude. Each custom has some social utility; it is serviceable in the maintenance of the group. Therefore, the sanction of utility which attaches itself to certain customs makes them right in practice. Parricide may be an adjustment to an inhospitable environment. Thus these sanctions are unconscious attempts to maintain the integrity of the group. All in all, it must be said that so far as the results of scientific inquiry go, it is simply a fact that what some people call right others call wrong. The ancient Greeks without the benefit of the techniques of modern science saw as much and drew the same conclusion.

The relativism here implied is an objective relativism. The individual's behavior is no less narrowly or loosely constricted in the kind of relativistic system here described than in one where moral values are assumed to have a supernatural sanction, are absolute. The individual is a victim of the gross value or cultural system into which he finds himself born; that is, if he ever achieves sufficient self-consciousness and awareness to know it. Most persons never make that discovery. There is an unintentional conspiracy in every culture against any individual who makes that discovery, or, better, allows such a discovery to influence his behavior. When that stage of self-consciousness is achieved the individual may become critical of what is acted upon in the group as right. He may begin to wonder what is right, and if he does so long enough it may dawn upon him that he himself is as good a sanction for what is right and wrong as the group into which he was born. In fact, to the extent that he is a consciously creative and reflective creature, which the group never is, he may conclude that right and wrong are products of personality. When this occurs the objective relativism becomes a subjective relativism: the individual becomes a measure of moral values. There may thus grow up a situation in a culture where individualism and moral anarchy prevail to the extent that social control is all but nullified.

The broad implications which the statements just made entail are in a way shocking. What they imply is that man can live in any kind of moral order, providing that the relationships which are defined as moral do not outright curtail the life processes and the transmission of the social heritage. The usages and habits of men can, in the end, have no other significance than this; and so neither can the moral sanctions and ethical codes that are derived from them.

Higher and lower as terms of evaluation of different ways of life achieve their meaning from the common ethnocentrism which characterizes all collective behavior. The processes of collective behavior tend not only to provide for the survival of the individual but also of the group itself, which is, after all, also a repository of nearly everything that the individual can become. It is probably this dependence of the individual upon the group that leads him to exalt the ways of his own group over those of individuals born into other groups. When this explanation for cultural preferences is accepted, about all that remains to be said is that different peoples show a wide range of knowledge concerning the objective world and adaptations to it in the way of inventions and discoveries, and that no knowledge or set of adaptations can do more than provide for the perpetuation of the group biologically. Therefore, to attribute to the habits and usages which prevail in a group superiority on other grounds than this is a kind of error of judgment. To attribute to the habits of the group into which one happens to be born evaluations of higher and lower is simply to make what one knows and does a standard of measure. Better still, it is making the accident of birth into an exercise of will, of choice. The slogans of patriots everywhere are of this order of behavior.

The scientist can find no support for the widely disseminated view that moral sanctions are of supernatural origin. In fact, the pretense that ethical behavior is supernatural in origin may itself be only a further aspect of the general situation of group living in which the individual finds himself. Usage and wont make things respectable and then sacred. Conventionality breeds fear: fear of the new, fear of changes. This fear may in time be metamorphosed into some-

thing other-worldly and then come back to the individual through the group as a sacred sanction for whatever it is that is done. But whatever the explanation for the frequent belief that morals have a supernatural basis, the scientist must simply reply that he knows of no such thing. The world of morals, he concludes, is one with the growth of tree; a series of events of naturalistic origin. Both morals and trees have a natural history.

The ascendency or victory of one cultural or moral system over another comes down, for the scientist, to a study of the processes of social change. Specifically, it is a study in cultural diffusion. He cannot argue, however, the proposition that "might makes right." He does not *qua* scientist know what right means. Further, if he is at all a discerning individual, he will be quick to detect that the phrase "might makes right" is a confusion of meanings. The rightness of an act or mode of behavior is something different from the strength or force necessary to impose an act or mode of behavior upon another person. In fact, to say that "might makes right" is the same as saying that there is no "right" at all. The appeal to force can only show who is the stronger in combat. The moral issue involved in either case is left undecided. The referent of right is always an ideal, a belief in a higher moral order. Thus the Christian-pacifist may be eternally right and yet be beaten out at every turn by things as they are. Therefore, while the scientist cannot traffic in such words as "right," he distinctly does not give aid and comfort to the theory of combat morality and its protagonists. Things as they are are facts, not values.

A recognition of the confusion of meanings in the phrase "might makes right" does not prevent the scientist from observing that one conquest group may, and often does, simply because of a preponderance of force, impose its moral system on the conquered. How successful a conqueror will be in imposing his system of cultural preferences on the vanquished depends upon a number of factors. Not the least of these, in modern times, is that conscious ethnocentrism called patriotic nationalism. Another is the comparative differences in the contending cultures. If these are too great, as in the instance where an advanced people invade the primitive world, the shock of the impact may actually exterminate the aboriginal peoples. On the other hand, where likenesses are great, as among moderns, an attempt to impose alien culture preferences may create a conflict situation which in time may be resolved in a process of fusion known as syncretism. The old and new usages blend as they become adapted to the larger sphere of interaction.

The point of the foregoing, however, is that while might and right are words from two different universes of discourse or levels of thought, it is true as a matter of fact that the survival of a moral system may depend upon a preponderance of force. Passive resistance, or negative force, may achieve similar ends. The goodness or badness of a system is not at stake in these interactional processes, excepting as these terms may be used to mean that the habits and usages which achieve ascendency possess greater group utility than those which are suppressed, i.e., they assure perpetuation of the race and transmission of the social heritage.

THE scientist's attempt to treat morals scientifically really ends up without there being any good and evil, right and wrong. The use of such words by him is a convention, a manner of speaking. The attempt to provide a mechanical accounting for moral behavior, or what is so called by the non-scientist, is to end up with statements implying description and analysis of sequences of events in time and space. The scientist can give an account of what is called evaluation; that is, he can lay out the causal nexus for that kind of behavior, but he himself can do no more than admit that the "facts" in the chain are indifferent, without attributes of praise or blame. So far as his investigations go, he cannot distinguish between the self-sacrifice of a mother cat for her kittens and that of a martyr-saint for his God. The behavior mechanisms involved are similar, they differ only in quantitative complexity. Indeed, he may even aver that all kinds of behavior involving choices are of a kind with plant tropisms.

The scientist as scientist stands neutral with respect to the clash of wills and ideals which goes on about his ears all the time. His world is, if not cold, at least gray. Were he to admit to himself for one minute that this were not so, the great edifice called science with a capital S would come crashing down. Objectivity is not a fetish, a creed, a dogma of science: it is a condition. Without it there can be no knowledge of how things work. Admit bias or prejudice into an observation—intentionally—and the results are rubbish. But the scientist is also a man, a bundle of culture preferences and value judgments. Thus he will, at his country's bidding, perfect propaganda techniques so that his fellow nationals may be more readily led into battle, and at the same time, and with that great show of scientific impartiality and cosmopolitanism which has always been in the scientific tradition, publish his results in a professional journal available to his colleagues in an enemy country, who then proceed to apply the same propaganda techniques to the end that the carnage may be more ghastly and more complete. And then at the conclusion of hostilities these brother scientists may meet at some international conclave, compare notes on the successes of their respective efforts to do the bidding of their respective sovereigns, and deplore the collective stupidity of the human race.

What the scientist cannot do as a research worker, namely, admit values and preferences into his calculations excepting as data, he admits as a man. The criterion of relevance is for him, as for all of us, socially induced. The problems he works on reflect the ethos of time and place. The fact that moral values disintegrate under the methodology of science does not mean that there are none. It only means that science is not competent to deal with issues of right and wrong. The anthropologist or sociologist, after subjecting all evaluation to the corrosive effects of scientific analysis and announcing that all values are relative, is, perhaps, no less ethnocentric than the man in the street. And it goes without saying that the physical and biological scientist is nearly always so, and does not know it. In any event, nearly all scientists in wartime are patriotic nationals, and in peacetime generally in the service of the mighty.

The complaint that while scientists do not traffic in values as scientists, they do take for granted the existing value system, which defines and gives meaning to their researches, is one that cannot be easily evaded. The unconscious ethnocentrism which today receives the calculated support of scientists everywhere, without hardly a single exception, is a case in point. Such lack of awareness is a poor reflection of the humanism and cosmopolitan rationalism which was the main encouragement of the scientific enterprise in the beginning. There was a time when men of mind expressed only contempt for the vainglorious show of politics and war. But today the man of science has become a hireling, a willing subject in the service of the nation-state; an indefatigable combatant in the righteous cause of a finite warrior god.

On the other hand, we should be fair. Memory is short and time is long. Men of science begin their lives as children, as we all do. They too are victims of their times, their parents, their teachers. It shows little awareness of the nature of the social process to accuse a single group for the shortcomings of the human enterprise. The devil theory of social causation, even if it were true, falls short of the condition of control. The truth is, it was not until man's growing empire over nature, and the expanding world of interaction which came with it, clashed with the parallel tendencies, historically, of the factory system, territorial localism, and democratic totalitarianism that the loud warning was given to be on the watch for moral incompetency among scientists. The man of science cannot be held accountable for the tradition known as Western European Civilization. Others beside himself, including priests, soldiers, and merchants, had a hand in making it.

There is one aspect of the scientist's relationship to the social order which cannot be glossed over. It has admittedly been the self-imposed task of scientists to discover and invent the conditions of the desirable life. That was their campaign propaganda in the beginning and it still is. "Give man-

kind power over nature," the argument runs, "and the use of that power will not be abused." But it has been abused in more ways than one likes to recall. The checks they themselves appealed to, they have themselves also destroyed. No scientist pretends any longer to know what sound reason and true religion are. These spontaneous controls which Francis Bacon exalted in the *Novum Organum* to silence the doubters in his own time have gone the way of all myths. It is not stating the case against science too strongly to say that men of science have done more than they know to place the moral life in jeopardy. The humble people everywhere are today farther away than at any time during the nineteenth century from that cosmopolitan humanism which it was explained to them would be their reward if they followed in the wake of scientific research. The simple faith of the millions has been rewarded with more efficient weapons for consecrating tribalism, and better instruments for nurturing a meanness of spirit.

A weakness in the scientific approach to problems of social order from the first has been the faith that man's innate good sense will prevent the misuse of power over nature. The winning of power over nature has tended just for that reason to become an end in itself, and generated among many men of science the comfortable conviction that they share no moral responsibility in deciding to what uses their discoveries and inventions are put. To affirm the contrary in the presence of these men is to be accused of asperity and branded as a science-hater and a demagogue. The outcome of this state of affairs has been that the spirit of adventure in discovery has overshadowed all else in science, and has even become a general attitude. People have forgotten the reasons for the acquisition of material riches. Acquisition has become an end, not a means to better living. Rest days and holidays have actually become fewer with the rise and progress of science. A kind of blindness in this respect is afflicting all of us. A state of affairs is developing where people are beginning to be increasingly burdened with the situation of not knowing how to make intelligent disposition of the abundance of the factory and the farm on the one hand and a growing awareness of an exhaustion of the basic resources of the earth in the face of a declining population on the other. And piled on top of this dumb show is the paradox that only a few any longer affirm a joy in working.

The conclusion to which we are brought is that the winning of power over nature has not effected the good life. The tools of science are powerless to decide the good life. The results yielded up by science are empirical and relational. If we should wish to call a given social and moral order more desirable than another, the tools of science can conceivably provide the means for its attainment. Or they might be used to decide, conditionally, an issue involving a conflict of means respecting lesser as well as greater goals. The scientist can point out a relational agreement or conflict in empirical knowledge and an existing social and moral order. But man *qua* scientist cannot decide which is the better social and moral order. The man of science cannot even decide against those who would cut him off from the opportunities of being a scientist. He is powerless against both his enemies and his friends; from those who would destroy him as well as those who would crush him in their affectionate embrace. Whichever alternative confronts him he can only face the situation with the knowledge that the universe is a chaos, and that whatever order man finds in it is the outcome of his efforts to gain a living.

BIOLOGISTS IN THE NATIONAL ROSTER[1]

By ROGER C. SMITH[2]
PROFESSOR AND HEAD OF DEPARTMENT OF ENTOMOLOGY, KANSAS STATE COLLEGE

A STUDY of the registrants in the general field of Agricultural and Biological Sciences in the National Roster of Scientific and Specialized Personnel reveals certain facts that may be of interest. As indicated on page 287 of the SM for October 1945, the total registration in this field as of December 31, 1944, was slightly under 6 percent of the total Roster registration of 440,000, or about 26,000 individuals.

A representative sample of registrations in this field yields the distribution by principal professional fields given in Table 1. These figures are based on the registrants' own statements as to the fields in which they considered themselves primarily qualified.

TABLE 1

THE PERCENTAGE DISTRIBUTION OF ROSTER REGISTRANTS IN AGRICULTURAL AND BIOLOGICAL SCIENCES BY PRINCIPAL PROFESSIONAL FIELDS

Forestry	17.4
Agronomy and Soil Science	9.5
Bacteriology and Immunology	9.0
Entomology	6.9
Zoology	6.4
Botany	5.2
Horticulture	5.0
Dairy Science	4.9
Plant Pathology	4.7
General Biology	4.3
Physiology	4.1
Animal and Poultry Husbandry	4.0
Medical Pathology	3.7
Anatomy	3.3
Wild Life Management	2.2
Genetics	2.1
Plant Pathology	2.0
Parasitology	1.7
Nutrition	1.7
Range Management	1.0
Wood Technology	0.9
Total	100.0

The median age in all these fields is 38.5 years, the lowest being General Biology, 35.5 (which probably includes a large proportion of senior students) and the highest, Medical Pathology, 46.9. The median age of all Roster registrants is 37.9 years.

Registration of individuals under 29 in the fields of Entomology, Plant Pathology, Plant Physiology, and Anatomy is relatively small in comparison with other fields. It is a question whether this is a coincidence or is due to some lack of employment opportunities in prewar years.

The number of women in Agricultural and Biological Sciences is relatively small, 92 for every 1,000 men. However, in Human Nutrition there are nearly twice as many women as men. In the fields of Botany, Bacteriology, General Biology, and Zoology there are from one-fourth to one-fifth as many women as men. Forestry, Range Management, Wood Technology, and Agronomy and Soil Science are at the bottom of the list with a ratio of 2 to 3 women to 1,000 men.

A tabulation of the industrial associations of registrants in the Agricultural and Biological Sciences is not only interesting but somewhat unpredictable. The data on which Table 2 is based were drawn from representative registration records excluding all who

TABLE 2

THE PERCENTAGE DISTRIBUTION OF ROSTER REGISTRANTS IN AGRICULTURAL AND BIOLOGICAL SCIENCES BY KINDS OF EMPLOYERS

Colleges and Universities	45.4
U. S. Department of Agriculture	17.1
Conservation of Resources	4.5
Hospitals and Clinics	3.0
Farms and Agricultural Services	2.2
Drugs and Insecticides	2.1
Dairy Products	2.0
U. S. Department of the Interior	1.9
State and Local Public Health Service	1.5
Lumber and Timber	1.1
Nonprofit Research Agencies	1.1
Secondary Schools	1.0
U. S. War Department	0.8
Libraries and Museums	0.8
Industrial Chemicals	0.7
Trade and Professional Associations	0.7
All Other Fields	14.1
Total	100.0

[1] Published by permission of the Director of the National Roster of Scientific and Specialized Personnel, War Manpower Commission.

[2] Former Professional Specialist for the Agricultural and Biological Sciences, National Roster of Scientific and Specialized Personnel.

were known to be in the Armed Forces and all students.

Since the figures in Table 2 are based entirely on Roster registrations, absence of a significant number of individuals in fields commonly regarded as open to those with biological training may mean only that the Roster does not have as broad a coverage in these fields as in the engineering and physical sciences. There are also a few fields in which biological and agricultural specialists would appear to be out of place. In some cases examination of individual records has shown that biological backgrounds were being definitely used in these fields. For example, wood technologists are useful both in aircraft and shipbuilding industries. In other cases biologists were working at tasks requiring no biological training simply because of lack of employment opportunity in industries where they would normally be. The larger part, however, of those included in the heading "All Other Fields" are definitely in work in which their previous training is being used.

Roster registration permits individuals to record their order of competency in several fields. It is interesting to note the apparent versatility of registrants in some of the Agricultural and Biological Sciences. For example, out of 320 individuals claiming professional knowledge of Plant Anatomy, only 86 gave it as their first field of competency, while 94 regarded it as their second field, 70 their third, 47 their fourth, and 23 their fifth.

In 1943, the National Roster conducted a survey to determine the personnel situation in Agricultural Sciences. In addition to material from other sources the Roster secured returns from 48 out of 53 state and territorial experiment stations and from 38 of the 51 state and territorial extension services. Also 63 out of 99 colleges giving training in agriculture reported on their personnel situation, including faculty, research staffs, graduates, and students. In all the above types of institutions the additional requirements were estimated as being 15.3 percent and losses to the Armed Forces between September 1, 1941, and July 15, 1943, were 25.2 percent based on employees as of August 15, 1943. In this survey it was found that 73.9 percent of the 1942–1943 graduates with the bachelor's degree had entered the Armed Forces; of those receiving the master's degree in that period only 34.1 percent had left civilian occupations and 8.3 percent of the small number of Ph.D.'s. Twenty fields were surveyed.

PLACEMENT SERVICE OF THE NATIONAL ROSTER

The National Roster of Scientific and Specialized Personnel is taking an active part in finding positions for returning veterans who are professionally qualified. Arrangements are being made with the Armed Forces to furnish veterans with return postcards indicating the field of specialization and type of employment wanted; and, in addition, separation centers are being provided with lists of positions available and application blanks in order that employers may be promptly informed regarding the training, experience, and qualifications of scientists and engineers who are returning to civilian life.

Many employers who have operated large emergency war plants are not able to retain their full staffs and a considerable number of fully qualified individuals are being released.

While there is undoubtedly a shortage of professional personnel, in a number of fields, it is a very large undertaking to bring the right jobs and the right people together. The Roster is prepared to cooperate with all agencies, industries, educational institutions, professional organizations, and members of the technical and scientific professions in order that the fullest possible employment may be secured.

The address is: National Roster of Scientific and Specialized Personnel, 1006 U Street, N.W., Washington 25, D. C.

THE NATURALIST'S DILEMMA

By ALEXANDER F. SKUTCH

At every epoch there lies, beyond the domain of what man knows, the domain of the unknown, in which faith has its dwelling.—AMIEL.

SPACE is the most obvious component of the universe—unlimited, unfillable space. But what is space? Next comes matter, which in its totality occupies but an infinitesimal fraction of space—not so large a proportion, perhaps, as that of the fishes and other animals of the oceans to the whole body of water. But who can explain the essential nature of matter? Of spirit and intellect we have no certain, scientifically demonstrable knowledge except in ourselves; and yet, with how much dross and base metal do we find them alloyed in man.

We seek unendingly for that which, by virtue of its affinity to our inner selves, we can understand—for that which is spiritual. It has ever been so. Primitive man gropingly sought the spiritual element among the stars, in mountains, rivers, rocks, trees, and animals. He invented a whole army of deities, great and small, to dwell in the heavens, with tritons to people the seas, nymphs the rivers, dryads and fauns the woodlands, gnomes the rocks and recesses of the earth. His quest for spirituality was not unalloyed with grossness and bestiality, as was to be expected from his own nature.

Even today the finding of a new star, containing some thousands of trillions of tons of matter, would not excite so much popular attention as the announcement of proof of the existence of the smallest sentient being upon some other planet. In this the minds of the mass of men follow a true instinct, which doubtless they would not be able to account for. We value things in proportion to their rareness and the difficulty of acquiring them. As the discovery of gold excites greater attention than the finding of yet another deposit of iron, so must proof of the existence of other spiritual or intellectual beings command more interest than the demonstration of still more matter. Yet if we could see truly, perhaps we should find spirit coextensive with space, and matter but one of its varied manifestations.

But of all the age-long quests of mankind none has been more baffling, none has yielded a richer harvest of heartbreak and disappointment, than the search for infallible proof of the spiritual element in the universe. Spirit and intellect are closely associated in ourselves: we feel and think, hope and plan, suffer and try to explain suffering, with the same organ. On the whole, intelligent men are more responsive than dullards to spiritual influences, such as beauty, nobility of character, loftiness of sentiment, and unselfish love. The relationship is not always simple and straightforward; in one man intellect seems dominant; in another, the spiritual qualities are the more obvious; yet the two somehow go hand in hand. Still—and this is the greatest and most exasperating of paradoxes—the intellect appears to be incapable of demonstrating to its own satisfaction the existence of spirit, or even of intelligence outside itself. We draw analogies and point probabilities and ask ourselves how otherwise can it be, but no man—begging Spinoza's pardon—has been able to demonstrate, by approved methods of logic or science or mathematics, the existence of a Supreme Spirit. In the ultimate analysis, we know or fail to know Him through the mysterious workings of the spiritual element in ourselves; and no crushing weight of arguments, pro or con, can make us effectively deny the verdict of our spirit. Thought and investigation have swept away many false and repulsive notions of the deity; but I doubt whether they have ever crushed, or ever implanted, the feeling of a supreme spiritual Being in any human breast.

The quest for the spiritual element reveals in the seeker the same limitations, the same insufficiency for the discovery of truth, the same ultimate doubts, whether he directs his attention to creation as a whole or to the smallest of created things. And is not this the outcome we might expect? For the spiri-

tual element in each of us, in every living creature, appears to be derived from the same great source of spirituality; and the demonstration of the smallest part of spirit is attended by the same difficulties as surround the proof of the existence of the Supreme Spirit from which it flows. And being subject to the same difficulties, it has the same importance; for the parts bear witness to the existence of the whole.

The inner, spiritual, or mental life—as we may choose to call it—of the living creatures which share the earth with us is one of the most fascinating, as it is one of the most important, objects of human curiosity. This bird that sings so sweetly in my shade tree, this dog that follows me so faithfully around, this horse so obedient to the touch of my rein, this squirrel chattering among the boughs, what does it think, what does it feel, what does it hope? Is its apparent affection anything deeper than eagerness for another meal, its love more than a brute appetite, its parental devotion more than the unconscious manifestation of a blind instinct? Does it in truth, as some have held, cry without pain, eat without pleasure, sing without joy?

These and a hundred similar questions constantly assail the thoughtful observer of animals. We need their answer with pressing urgency. We need it, first, because many of us must daily deal with animals in a practical way. How can we treat them with intelligence, justice, and humanity unless we understand what they really are? We call ourselves the lords of the earth; as such we wield power over all the rest of its inhabitants. But how can we be wise, moderate, and benign sovereigns, rather than arbitrary, merciless tyrants, unless we know the true and inward nature of our subjects? This, then, is the more immediate and practical importance of understanding the inner life of our fellow creatures on this globe. But the subject bears a still vaster significance by virtue of its connection with man's age-long, unending quest for the spiritual principle in the universe at large. The recognition of any smallest part of spirituality points toward the source whence it flows. Indeed, if we follow the inductive method of science, we shall strive to understand the parts before we attempt to grasp the magnitude of the whole.

The naturalist who occupies himself with the habits of living creatures in their native haunts ought, if anyone, to be able to answer some of these urgent questions, to tell us something of the inner life of the four-footed or feathered beings he so patiently watches. No other outcome of his studies—no description of the appearance, or details of the food, or enemies, or mode of reproduction, or length of life of an animal—can be quite so important as this. If he can answer our questions, we ought to honor the naturalist along with the greatest of philosophers and venerate him as a prophet.

But alas! your naturalist is only an ordinary mortal, subject to all the humors, whims, moods, prejudices, and limitations of knowledge and of insight to which his species as a whole is liable. And his problem, as we have seen, is the same in kind as that which has baffled the philosophers and seers of all ages—is, in fact, one aspect of this great problem. Hence, a revealing analogy arises between the metaphysical philosopher and the student of animal psychology. It is a common observation that a man's philosophy is colored by his temperament, the state of his health, and all his spiritual yearnings. Or, to express the same thought in other language, the riddle of the universe has been inscribed in such characters that a man reveals his whole personality in his attempt to decipher it. And, by an exactly similar law, a naturalist's interpretation of the behavior of animals tells you what he hopes to find in Nature. If he expects to discover in living beings only more complex examples of the operation of the laws of physics and chemistry, he will be a mechanist. If he seeks only material with which to experiment in a psychological laboratory, without taking into consideration the possible agonies of his subjects, he will be a behaviorist. If he prefers to devote his attention to the mystic manifestations of incomprehensible forces, he must perforce become a vitalist.

We derive from our studies what we put into them. If love and sympathy enter into our efforts to understand Nature, we shall see love and kindness in her children. If we

start out obsessed with the notion that Nature is red in tooth and claw, we shall find no end of fangs and talons dripping gore. If we devote to our investigations cold intelligence alone, we shall discover nothing but cool facts, upon which we base certain more or less exact generalizations. Our philosophy, our views of Nature, are inevitably tinged by our personal penchants.

It is commonly held that animals—the term being used to include the whole animal kingdom except ourselves—are guided in what they do largely by "instinct." This is a most unfortunate generalization. We have hastily pasted a label over the entire class of phenomena we strive to understand, and then find that we cannot read the inscription on the label. For since none of the things we do ourselves are instinctive actions according to the general acceptation of this term, we are cut off from the simplest and readiest—perhaps the only—means of understanding what an instinct really is. We have our reflexes, as when we start at a sudden loud noise, or blink our eyes, or grasp whatever is within reach to save ourselves from falling. But all our more complex activities, involving a whole series of simple muscular actions, have been taught us, or we have learned by reason and experience how to go about them. We build a house or a chair as we have been taught to make them, or as we are guided by reason or experience to improve upon the current models. A bird, we say, fashions its nest by instinct. No pattern of comparable complexity is included in the baggage we bring into the world with us. If it were, human education would be immensely simplified. If we could instinctively write, read, cipher, give the important dates of history, and name the parts of a flower, we might start years earlier to explore the unknown.

A bird builds her nest! I have watched a hundred kinds of birds build more nests than I can recall; I have counted their comings and goings and identified the materials they use. But the construction of the nest is still a mystery to me. Does the young bird, beginning her first nest, start out with a mental picture of the completed structure? She might, of course, have studied the nest in which she was hatched and fledged, made inward note of all its so various materials, and learned exactly how each was employed; but I think this would call for a degree of infantine observation far more astounding than any manifestation of "instinct." Moreover, the birds which construct the largest and most elaborate nests were raised in the dark interior of similar nests, where they could see but a small part of the whole edifice, and that but dimly in the poor illumination. I forget what naturalist it was who attempted to evade the difficulty of the first nest by supposing that a bird breeding for the first time always mates with an older partner who had previous experience in nest-building; but he must have known nothing of the habits of hummingbirds and many others, of which the female always builds without even the presence of a male.

If a young bird starts her first nest with a picture of the finished structure, I think it more probable that the picture is innate than that it is acquired in infancy. Does she know why she builds; does she foresee the eggs, the newly hatched nestlings, the fledglings in their first plumage? Or does all the marvelous process of rearing a family of young birds unfold before her stage by stage as, foreseeing nothing, she proceeds from step to step guided surely by "instinct," in much the same fashion as the plot of a new novel develops before us as we turn the pages of the book, or as our own life opens before us with the passage of the years? There are naturalists who claim that since the actions of the bird during the breeding cycle are "instinctive," it foresees nothing and so fashions its nest without foreknowledge of the purpose it will serve. These naturalists have treated us unkindly; they have withheld from us the sources of their information. Without access to their secret founts of knowledge, I am unable on my own account to answer the questions raised in this paragraph.

Instincts, as we commonly conceive them, savor strongly of the Innate Ideas of Plato. May it not be that a bird, before escaping from the shell, was equipped with an idea of a nest, and a migration route, and what

is and is not good to eat, and did not lose its knowledge upon hatching, as men forget when they are born? Had Plato been a bird-watcher, he would undoubtedly have found in the instincts of birds additional support for his theory of Innate Ideas.

But perhaps birds, like men, forget what they knew in an earlier existence, only not so completely. Birds may make blunders in building their nests, sometimes, for example, trying to place them in positions where they will never find adequate support, as in the angle between the tip of a leaf and the neighboring stem which it loosely touches. It is instructive to watch the building operations of colonial birds, such as the oropéndolas of tropical America, which may hang a hundred of their long, skillfully woven pouches from the terminal twigs of a single great tree standing in isolation from its neighbors. The wide-spreading crown offers an almost unlimited choice of twigs, suitable for the attachment of the nests; the slender vines, strips of palm and banana leaf, and other fibrous materials needed for their construction are equally accessible to all the birds. Yet, with equal facilities, some of the oropéndolas blunder along and take twice as long to complete their nests as their more adept sisters. Are these slow, blundering workers young birds building their first nests? Unfortunately, we have no means of distinguishing the old birds from the young. But these and many other observations for which we lack space lead me to suspect that instinct is not the infallible guide it is commonly held to be, that it must often be supplemented and perfected by experience, observation, and practice—in short, by learning.

No example is more commonly cited to prove the "blindness" of instinct than that of the pair of small birds who go on stuffing a young cuckoo with food, while their own proper nestlings, thrown out of the nest by the more powerful foster child, lie cold and starving on the ground in plain sight. It seems to me that the situation could as well be interpreted to illustrate the insufficiency of reason. Who knows but that the foster parents, like the Lacedaemonians of old, wish to raise only the most vigorous babies? Or maybe they are only making the best of a bad bargain; for the great majority of birds are unable to lift their offspring, and an unfeathered birdling that has fallen from the nest is irretrievably doomed.

Still, the habitual, routine activities of animals are attributed to instinct, and since we are not in a position to know the degree of consciousness that attends instinctive actions, their study scarcely helps us to understand the inner life of these animals. But we may attempt to further our quest by considering those exceptional actions of animals which appear to be guided by intelligence, because we know from personal experience something of the state of mind in which intelligent or rational activities are carried on. We know, for example, that we do not create any object—except accidentally, by the rarest chance—without beginning with at least a vague mental picture of the thing we desire to make; while we are not sure whether the bird starts out with an image of the nest in whose construction she is guided by instinct. I would not have it inferred from this that I hold reason to be "superior" or "more marvelous" than instinct. Reason appears superior for certain purposes and inferior for others. Both are equally wonderful, and in the ultimate analysis equally difficult to explain. If instinct has its deficiencies and blind spots, one has only to cast his eyes about the world of today to be convinced that reason also is subject to exceedingly grave limitations and aberrations; so that as a guide to action it is very doubtful whether it is more to be trusted than instinct. For instinct is almost always clear and sound as to its purposes, although likely to become confused in applying unfamiliar means to its ends, or in following its ends amid strange circumstances. Reason's greatest danger lies in its propensity to become confused, morbid, or self-destructive in its purposes, for it is less intimately in touch with the full, strong currents of life. I suppose whether one would prefer to lead his life by instinct or by reason depends largely upon whether he is conservative or radical at heart. The single point that I wish to emphasize here is that, since so many of our own activities are

classed as rational, we are in a better position to understand such of the activities of animals as we can place in this category than we are those which we attribute to instinct. How little we understand instinct may be gathered from the fact that we apply the term indifferently to creatures so diverse as, let us say, birds and insects. If zoological affinity is a guide to the inner life, as it is to the structure, of animals, then—although both birds and insects are said to be led by instinct, and men by reason—in their psychic life birds must nevertheless resemble men far more closely than they resemble ants and bees.

So, unhappily, in our quest to discover something of the inner or mental life of animals, we must turn our backs upon all those actions classed as instinctive, which include by far the greater part of the things we see them do. The supposed nature of instinctive behavior is the chief support of those who would see in animals only machines made up of flesh and blood rather than metal and wood, mechanisms that sing without pleasure and emit a cry without pain.

Since our endeavor is to discover the whole inner life of animals, which includes feeling as well as thought, we are free to consider expressions of emotion as well as manifestations of intelligence. But here again we run into grave difficulties. Birds, in particular, we believe to be emotional creatures; in them, as Julian Huxley has pointed out, "emotion, untrammelled by much reason, has the upper hand." Their expressions of emotion are vivid and varied, calling into play voice, wings, and often the whole body. Thus, mated birds of the most diverse kinds, upon becoming united after a temporary period of separation, greet each other with voice and quivering of wings, at times with a brief musical phrase reserved for this purpose, and often in the nesting season with complex ceremonies involving the presentation of nest material, and antics which remind us strongly of a caper of joy and a loving embrace. It is difficult for one who witnesses these greetings to resist the impression that they are the spontaneous effusion of genuine affection. But as we continue to watch birds we learn that in each species the ceremony of greeting follows a more or less fixed pattern. We may compare it with a salutation and a handshake or, if we will, an embrace and a kiss, which are conventional forms of greeting among men. But there are hand-grips in which we feel all the warmth of years of friendship; there are hands as responsive to our own as the handle of a broom; and again, there are hand-clasps in which we detect a deceitful substitute for the punch that time and place forbid. A third person might find it difficult to interpret the emotions of two strangers whom he watches as they shake hands. And even kisses bestowed upon relatives vary, as every child knows, from expressions of warm affection to feelingless compliance with parental dictates. If it is so difficult to interpret the emotional content of conventional acts of greeting among other creatures like ourselves, how can we hope to do so with any degree of confidence when the protagonists are birds so very different from ourselves?

Thus, emotional displays after a fixed pattern had best follow other instinctive forms of behavior, like nest-building and food-hunting, into the limbo of things which will not help us in our present quest. Since the conclusions we strive to reach will be of the utmost importance, we must be exceedingly cautious and discriminating in the selection and interpretation of our facts, even at the risk of inclining toward skepticism in our recoil from credulity. Already we have little left. Still, there remains a little. Birds are at times seen to do things in a way which does not appear to follow an instinctive pattern, but rather to be an individual, intelligent solution of a particular problem. Or they express emotion in a fashion which appears spontaneous and individual rather than conventional. Let us turn to these actions which, from being uncommon and rarely witnessed, seem to be the peculiar behavior of the individual rather than the instinctive behavior of the species. Let us see if they throw light upon the nature of a bird's mind.

SEVERAL species of yellow-breasted flycatchers, common and widespread in tropical America, build large nests with a domed roof that keeps the interior dry during heavy

rainfalls, and with a round doorway in the side facing out from the supporting tree. Usually the birds construct the commodious edifice entirely by their own efforts, beginning with the foundation of coarse, dry weed stems and ending with the soft lining upon which the eggs, and later the nestlings, will rest. But years ago I watched a chipsacheery flycatcher (*Myiozetetes similis*)—the most widely distributed of these yellow-breasted architects—that built her nest in a most individual fashion. Her site was a small lemon tree, where a pair of scarlet-rumped black tanagers (*Ramphocelus passerinii*) were feeding newly hatched nestlings, in an open, cup-shaped nest such as the great majority of tanagers build. Before the chipsacheery had proceeded far with her work, some mishap befell the tanager nestlings, leaving their nest vacant. Thereupon the flycatcher claimed the empty cup and began removing the straws and weed stems from her newly begun nest and placing them upon the tanager's nest. Soon she had converted the open, cuplike structure into the domed nest typical of her own kind. In this she laid three eggs and raised her brood, only to have them carried off by a hawk when nearly fledged. By suddenly changing her plans when her neighbors' nest was left vacant, and using it as a foundation for her own, she saved herself the labor of hunting and fetching as much material as the tanagers' nest contained.

"A bird who knows how to think and plan!" I exclaimed to myself at the time. The sudden shift in procedure, to take advantage of a newly found opportunity, seemed to indicate forethought. It seemed incredible that a bird could convert a nest of one type into another of distinct style, without a mental picture of the completed structure. "Blind" instinct seemed inadequate to achieve such results.

In subsequent years I have never again seen a chipsacheery flycatcher effect such a conversion. But twice I have known a closely related flycatcher, the graycap (*Myiozetetes granadensis*), to select an abandoned open nest as the foundation of its bulky roofed structure. The chipsacheery that took advantage of the tanagers' deserted nest was not quite so individual a genius as I at first supposed, for other members of her genus are capable of remodeling nests in the same fashion. What am I to conclude from my fuller knowledge? That these yellow-breasted flycatchers are all intelligent birds, or at least produce a considerable number of intelligent individuals? Or that here is an instinct which manifests itself only when the bird finds an empty nest which fills certain requisites as to size and position, and at the period when it is beginning to build? The reader will be able to answer these questions as well as I. But this much at least we have learned: that an act which at first appears unique and individual may, upon longer acquaintance with a group of birds, prove to be more widespread than we at first suspected.

Let me cite one other example that warns us to exercise caution in concluding that behavior is individual, this time touching a display of emotion rather than of intelligence. A female blue cotinga (*Cotinga amabilis*), clad in a modest speckled dress of brown and buff instead of the intense blue and purple of the male, had built her slight nest among the topmost boughs of a great, spreading *yos* tree standing in a pasture at the edge of the forest, in the Costa Rican mountains. Late one afternoon the nest was discovered by a blue-throated toucanet (*Aulacorhynchus caeruleogularis*), a small green toucan with a great bill and an inordinate appetite for other birds' eggs and nestlings. My attention was drawn to the nest and its assailant by the loud, agonized shrieking of the mother cotinga. Peering up into the many-branched crown, I beheld the toucanet standing on one of the uppermost boughs in a defensive attitude, great bill raised in menace, while the cotinga darted angrily past its head, uttering cries of distress. Soon the toucanet flew off through the forest, and the cotinga vanished amid the cloud of verdure that was the crown of the *yos* tree. But a little later I saw her go to the fork of a thick, mossy branch at the very top of the tree, nearly a hundred feet above the ground. Here, standing upon a cushion of moss which enveloped the crotch, she picked up a billful of fine twiglets and let them fall to the ground, thereby revealing to me the position of her nest, which hitherto I had sought in vain. She repeated this act

so full of melancholy significance, lingered a few moments on the side of the nest in an attitude that suggested forlorn resignation, then turned about and darted away through the foliage. Later, both she and I found her well-feathered nestling which had been knocked or frightened from the nest and rested on the ground in the pasture below, and did our best to take care of it until it could fly. Mother-love brought this tree-top bird to the ground.

The lifting up and dropping of the materials of the despoiled nest was a heartbroken gesture which, it would seem, could be of no possible use in the struggle for existence, and hence could have no "survival value" which might cause it to become a general habit of the species. It appeared to be an individual expression of melancholy resignation. Nests of these tree-top birds are not found every day; and it is difficult to know whether the behavior I witnessed was peculiar to this particular cotinga or widespread in her species. So far as I am aware, the only other nesting cotinga of this genus ever watched by an ornithologist was a female of a closely related species (*C. nattereri*), which on two successive years attempted to raise a brood in a lofty tree on Barro Colorado Island, where she was watched by the sympathetic eyes of Dr. Frank M. Chapman. After the nestlings prematurely vanished, he saw the bereaved mother pull her nest to pieces, much as my blue cotinga had done. But because a mode of expressing emotion proves to be widespread, are we to conclude that less of feeling enters into it? Do not most of our own manifestations of emotion follow more or less definite patterns?

Last year, on the rocky shore of a wild, rushing mountain stream, I found my long-sought first nest of the black phoebe (*Sayornis nigricans*), a familiar figure along swift inland waterways of the milder parts of the American Continent, from Oregon to Bolivia. The thick-walled cup, composed of gray mud strengthened by bits of dead vegetable matter, was plastered to the nearly vertical side of a ridge projecting from the lower face of a huge, outjutting rock. Here, with a stony roof above and the rushing current below, it seemed inaccessible to all enemies and in danger of destruction only by a sudden rise in the current. The female built with the encouragement but not the help of her mate. When she had lined the hollow of the nest with soft grass and a few feathers and had laid her two white eggs, I decided to watch her as she kept them warm. Ordinarily I should have concealed myself for such a study; but the rocky shore of the wide torrent offered no convenient screening bush or any spot for the erection of my little brown wigwam. So, perforce, I sat unconcealed upon a mossy rock hard by the dashing current, beneath the shade of a wide-spreading, orchid-laden *sotecaballo* tree, about twelve yards from the nest.

When the female phoebe flew down the river and saw me watching so near her nest, she was afraid to return to it—not so full of fear that she fled precipitately away, but with just that degree of uneasiness which left her uncertain whether it would be quite safe to sit on the eggs in my presence. In this undecided state of mind she stood on the low rocks projecting above the water below her nest, and after a while flew up as if to enter it, but when still a few inches away lost courage and dropped back to the low rocks. Several times she started for the nest but always changed her mind before reaching it. While she delayed in this vacillating state, her mate arrived and hovered in front of the nest, beneath the huge overhanging rock. His presence gave her confidence, and without further loss of time she darted up and settled on the nest in front of him. Then he dropped down to stand quietly for ten minutes on the rock below, while she sat steadily upon the eggs above him. After he had gone away she continued on the nest three minutes longer, then flew off to catch insects.

When she returned to the nest after a recess of six minutes she still lacked courage to settle down upon it in my presence, despite the fact that she had already sat for thirteen minutes while I watched her from exactly the same position. As last time, she flew up very close to it, only to drop back to the low rocks again. Again and again she repeated this move, sometimes actually touching the rim of the earthen cup, but always in the end re-

turned to the low rocks. She flew across the river, then in a few minutes came back and continued her false starts toward the nest. But she could not quite gather courage to rest upon it, and in the end flew upstream to seek her mate.

Soon she was back again with the male, who went direct to the nest and perched upon the rim, facing inward. Now at last the female phoebe went to the nest without hesitation and settled on the eggs in front of him. He lingered beside her a minute, then dropped down to rest on the rocks below a minute or two longer. Then he flew away.

Through the remainder of my five-hour watch, the female phoebe would never enter her nest unless her mate were close by. Sometimes he would accompany her as she returned from her recess, and then she would promptly settle down to warm her eggs. At other times she would come alone and, standing on the rocks below the nest, call *chip* until he arrived to see her safely on it. Once, while he perched on the rocks on the opposite side of the river, catching insects above the water, she waited ten whole minutes for his arrival, meanwhile catching insects herself by darting out from the low rocks beneath the nest. Or, becoming impatient, she would go off in search of her mate, and finally bring him back with her.

The male phoebe would sometimes stand on the nest's rim, and then the female would go promptly to sit in it. Again, he would flutter momentarily in front of the nest, and this had the same result. Yet again, he would not go to the nest, but merely stand on the rock below. Then his mate would usually make a few false starts before she actually settled down. The male would always linger a while on the rock below her, for less than a minute to as much as ten.

This interesting conduct, unique in all my experience with birds, raised an important question. Was I witnessing the normal, unconstrained behavior of this pair—the way they would have acted if they could not have seen me; or was it that the female phoebe would not enter her nest in the absence of her consort because she lacked confidence in my presence and needed him to bolster up her courage?

To gather evidence upon this point, I returned in the afternoon and sat upon a more distant rock, now about fifty feet from the nest, but still with no intervening vegetation to screen me. Soon the bird returned alone, and seeing me there, hesitated a while and then flew off upriver, doubtless to seek her mate. But as he was not inclined to come just then she was obliged to come back without him; and again she stood on the rock beneath the nest, starting toward it as if to enter but lacking courage to do so. Another journey upstream, and a third solitary return to the nest; and now, since she could not prevail upon her usually so attentive mate to escort her, she had no recourse but to settle down on her neglected eggs in his absence.

During four hours of the following morning I watched the nest from the more distant rock. Now the female phoebe, becoming reconciled to my presence at the greater distance, settled upon her nest alone, with little or no hesitation. Of twelve returns to the nest after as many recesses, on nine she came unaccompanied; only three times, or at one-quarter of her returns, was her mate present. This may be taken as about the normal rate of occurrence of his pretty custom of seeing her on the nest—a custom practiced, with many variations, by a considerable number of monogamous birds of which the male does not incubate. He was present at every single return on the previous morning only because in his absence his consort would not settle upon her eggs. But later, when she had grown quite accustomed to my presence, she would enter the nest alone even while I sat only seven feet away. She gradually lost her distrust of me.

The behavior of this phoebe, which in the presence of a potential enemy would not go to her eggs unless her mate were close at hand, opens fascinating glimpses into the psyche of a bird—glimpses which, unfortunately, suggest more than they prove. It is for this reason that I have dwelt upon her conduct in such detail. I doubt whether her refusal to enter her nest, when afraid, unless her mate were close at hand, was instinctive in the sense that it followed a hereditary pattern. Only the study of several nests,

under similar circumstances, could settle this point. But certainly the conduct of this pair was not purposive in the strictly utilitarian sense; it had no "survival value." When an enemy too big or powerful to be driven away approaches the nest, birds do well to slink away in silence, on the chance that it will escape detection, not call their mates, for the presence of two attracts more notice than one alone would. But certainly the actions of this female phoebe were very humanlike. As all of us, she found courage, in the presence of one she loved and trusted, to do what she feared to do alone. And even, it seemed to me, toward the end she was taking advantage of the situation to win additional attention from her mate, coquettishly feigning a distrust she no longer felt, until at last she learned it would avail her no longer.

One aspect of the phoebe's behavior, her many starts toward the nest when her mate was not at hand, each falling short of it and ending in a retreat, is very widespread among birds under similar circumstances. Their attachment to the nest draws them onward, and their fear of a man or a strange object in its vicinity urges them in the opposite direction, and so they oscillate forward and away, until at length either parental devotion or prudence gains the upper hand, and they settle in the nest or leave it to its fate. How different is this vacillating conduct from the direct, straightforward action of the insect, which appears to be influenced by but a single motive at a time. This conflict of impulses in the avian mind closely resembles our own attacks of indecision. As everyone has experienced in himself, our consciousness is heightened by such stress of opposing emotions. The things we do and say in such circumstances are graven deeply upon the memory, while habitual actions frequently make so little impression that we cannot say an hour later whether we have done them. Who has not amused or vexed himself by continuing to search through his room for an object that he has mechanically slipped into his pocket? It is from this consideration that I believe we must look to the uncommon rather than the customary activities of animals, and to their conduct while beset by conflicting emotions, to throw light upon the dark and difficult subject of their psychic life.

A little, brownish, bare-cheeked Costa Rican Tityra (*Tityra semifasciata*)—a widespread member of the cotinga family—had built her nest in an abandoned woodpecker hole near the top of a tall dead trunk standing in a clearing in the forest. For her, nest-making was a simple process, consisting merely in the accumulation of a loose litter of small bits of dead leaf and dry twiglets in the bottom of the hole. A larger woodpecker's hole, only a few feet below that chosen by the Tityra, was the dormitory of four Frantzius's araçaris (*Pteroglossus frantzii*), a species of toucan much bigger than she, with huge red bills half as long as her whole body. The Tityra strongly disapproved of the presence of these inconvenient neighbors, which were probably not above making a meal of her eggs or nestlings; and each evening she, and sometimes also her mate, would pursue and dart at them as they flew to their high bedroom. But the great-billed birds took slight notice of the anger of creatures so mild-tempered as the Tityras. Finally, night closing down, the white male Tityra would fly off to sleep in the forest, leaving his mate alone in the clearing.

Left to herself, the female Tityra would rest upon the lofty top of the trunk that contained her nest and the araçaris' dormitory, or upon some neighboring eminence. Then, after a while, she would fly toward her doorway, but as she came close to it—and to the doorway of the araçaris whom she feared—she would lose courage and return to her high perch. Here she remained motionless, a very solitary and diminutive figure silhouetted darkly against the fading light above the western ridge, while all the bird world sank into hushed repose. What a struggle must have been taking place in her small breast as she rested, outwardly so quiescent, against the great, open, cloud-veiled sky! On the one hand, duty called her to pass the night in the nest, which had been completed and perhaps already contained the two mottled gray eggs. But just below it slept larger and more powerful birds that she feared, and she scarcely dared to slumber

so close to them—even if several feet of wood did separate the two cavities. Her thoughts must have turned with longing toward the sheltering tree where she was in the habit of roosting with her mate, in the forest far from these red-billed monsters.

At length, when even the late-retiring motmots and woodhewers had sought their sleeping places, and the bats had begun to flit through the dusk, the lonesome little bird made another move toward the round entrance of the hole, now scarcely visible in the darkening trunk. But in front of it her courage failed, she hovered on fluttering wings, then rose to rest once again atop the trunk. Five or six times more she started for her nest with the same negative result. At last, she winged off toward the forest to the south, whither she and her mate had gone together on previous evenings, and vanished amid the dusky foliage. She had not been brave enough to pass the night in her nest so close to the araçaris. But a few evenings later, with growing parental devotion, she found courage to enter the nest and sleep upon her eggs so near the dreaded toucans.

I believe it was Herbert Spencer who suggested that consciousness was kindled by the friction of conflicting impulses within creatures motivated by instincts. As she perched motionless against the darkening sky, the Tityra was without any doubt torn between opposing impulses. As I watched her from the pathway at the edge of the forest, sympathizing with her agitated state of mind, I found it hard to believe that she was not acutely conscious of her situation.

I MIGHT go on indefinitely to cite observations, made by others or myself, which seem to throw light upon the inner life of birds, to prove that they possess at least a modicum of reason, a high degree of memory, a dash of foresight, and such spiritual qualities as affection for their mates and young, devotion, courage, a feeling for beauty, a sense of play, anger, rage, and other attributes. But these examples will serve our purpose, since we are not here attempting to make an exhaustive exploration of a bird's mind but rather to understand the conditions under which such exploration is possible. I am well aware that clever students of animal behavior have devised experiments which make birds appear exceedingly foolish, their mental processes singularly blind. Yet even the older, less scientific literature is full of instances of the insufficiency of a bird's intelligence to meet all the contingencies of its life. But what of it? The books which deal with ourselves, our history and biography and fiction, contain far more numerous and far more ludicrous instances of the insufficiency of the human intellect.

Perhaps others who have watched intimately the lives of wild creatures have discovered, like myself, that every episode somewhat out of the ordinary which we are privileged to witness produces by turns two contrasting states of mind. There is the moment of sympathetic insight, when we enter—or fancy that we enter—into the feelings of the creature that we watch, and hardly entertain a doubt as to the motives which drive it to act, the emotions it experiences. Such intimate communion with the spirit of a creature so different from ourselves produces a warm glow that endures for a longer or briefer spell but sooner or later must cool, leaving only a memory. This state of exalted feeling is followed by what we may call the intellectual reaction, when reason sets to work, with all its upsetting questions and cautious doubts, to pluck apart and demolish the beautiful image which sympathy so readily created. Can we really know anything of the inner life of creatures so different from ourselves? Can we not explain all that we have seen on the basis of instincts, tropisms, behavioristic patterns, without calling consciousness into the account? Are birds, or other animals, actually capable of thinking, of loving dispassionately, of responding to beauty? These and a hundred more disturbing queries rise into our minds.

Hence comes the naturalist's great dilemma. But it is not a dilemma confined to naturalists alone. Every man not all spirit or all intellect—and doubtless there are few such—must experience it if he tries to pierce through the opaque mask of matter and reach the things that lie behind and beyond. The more nearly what we may distinguish briefly as the intellectual and the spiritual qualities

are balanced in him, the more bothersome this dilemma will be; if either of these qualities, spirit or intellect, has definitely the ascendency, it will trouble him the less in proportion to the degree of dominance of either. That man is indeed to be pitied who has not at least once or twice in a lifetime known moments of insight when great cosmic spiritual truths stood sharply and clearly before him; he is more than ordinarily fortunate if he has not at a later date focused the cold light of reason upon his revelation and come to doubt its validity. Such, on a smaller scale, is the common experience of the naturalist who would enter into the inner life of the creatures he studies, not merely record external details of behavior. We said at the outset that the quest for spirit was attended by the same difficulties, whether it be sought in the universe as a whole or in some humble creature of our fields or woodland. And, being subject to the same difficulties, it has the same importance, for the parts give evidence of the whole.

How, then, can we escape from between the horns of our dilemma? We might adopt an attitude of skepticism—which would do very well if we never faced the necessity for action. Aside from this negative middle course, whichever way we incline has its dangers. If we yield to our glimpses of sympathetic insight and give credence to them, we risk falling into scientific error. If we refuse to believe what cannot be demonstrated in a laboratory, we risk closing our eyes and ears to a whole section of reality, which, if recognized, would give depth and breadth of meaning, not only to our contacts with this or that living creature, but to life as a whole. If we elect this second course, we indeed cut ourselves off from the possibility of understanding aught of the psychic life of other creatures. Huxley long ago pointed out that the strict methods of science are inadequate to demonstrate the conscious processes of any human being except our individual selves. How, then, can we hope that they will reveal the inner life of members of other species?

So it narrows down to a question of whether we shall have faith in our flashes of insight or, denying them, cut ourselves completely off from all possibility of recognizing the spiritual element in the lives of other beings. For although spirit and thought appear to have their seat in the same organ, yet, strangely enough, only spirit can bear witness to spirit, and thought alone to thought. We may understand the inner life of another being only insofar as it bears affinity to our own inner life; only through sympathy can we enter into it. The naturalist, as we have seen, must inevitably be influenced by his own temperament and his own aspirations in the interpretation of the inner life of the creatures he studies, just as the philosopher is swayed by his own personality in erecting his system of the cosmos. For myself, each year I incline more strongly to put confidence in those rare flashes of sympathetic understanding that seem to penetrate the outer husk of a bird and reveal the life within; I believe that they are more likely to disclose the truth than those laborious analyses of behavior by which we attempt to discredit them. If I must incur the risk of error, I prefer to incur it with the gateways to the spirit open rather than shut. As in all questions transcending practical demonstration, each of us must make his own choice at his own peril. And every choice, if it avoids the hideous form of dogma, is entitled to respectful consideration.

UNCERTAINTY

The world is my idea. Well I know
That things exist because I think them so.
But see the impasse where such reasoning ends:
Whose is the mind on which my mind depends?

—CLARENCE R. WYLIE, JR.

OUR EVERYDAY RECKONINGS

By OYSTEIN ORE

PROFESSOR OF MATHEMATICS, YALE UNIVERSITY

AMONG the movie gags there are a few old stand-bys which are being renovated from time to time and which do not seem to lose their popular favor. One of them presents the inexperienced American who, when arriving in England, gets involved in the most awkward troubles in calculating prices and his change, while a kindly Englishman stands by explaining how in reality nothing could be simpler than a monetary system based on pounds, guineas, florins, crowns, half-crowns, shillings, pence, and even farthings. The audience leans back after it is all over with a satisfied feeling of how much simpler and better all this has been taken care of in the progressive U.S.A. with its ideal dollars and cents.

Of course, there have been and will be attempts to simplify the English system of coinage; societies have been organized for this purpose and bills have been submitted to Parliament. However, all attempts have run up against a wall of opposition to any changes in the traditional system, with some sound reasons behind certain objections but also with arguments at times bordering on the ridiculous. To give a sample, let us quote a few remarks made in a speech by Mr. Lowe, member for Kidderminster, in the debate on decimal coinage in July 1855, quoted with some indignation by de Morgan in his Budget of Paradoxes:

> From a florin they get 2⅔ths of a penny, but who ever bought anything, who ever reckoned or wished to reckon in such a coin as that (Hear, hear).
>
> Such a coin could never come into general circulation because it represents nothing which corresponds to any of the wants of the people.
>
> What would be the present expression for fourpence? Why, .0166 (a laugh); for threepence? .0125; for a penny? .004166 . . . and so on ad finitum (a laugh) for a half-penny? .0020833 . . . ad infinitum (a laugh). What would be the present expression for a farthing? Why, .0010416 ad infinitum (a laugh). And this was the system which was to cause such a saving of figures, and these were the quantities into which the poor would have to reduce the current coin of the realm. (Cheers.) With every respect for decimal fractions, of which he boasted no profound knowledge, he doubted whether the poor were equal to mental arithmetic of this kind (hear, hear), and he hoped the adoption of the system would be deferred until there were some proof that they would be able to understand it; for, after all, this was the question of the poor, and the whole weight of the change would fall upon them. Let the rich by all means have permission to perplex themselves by any division of a pound they pleased; but do not let them, by any experiment like this, impose difficulties upon the poor and compel men to carry ready-reckoners in their pockets to give them all these fractional quantities.

The comments upon the reasonings of politicians are gratuitous. Yet, consciously or unconsciously, there are few of us who can feel ourselves free, at least occasionally, from substituting feelings for reasoning when it comes to finding arguments against changes in our old and adopted and accepted ways.

The reforms in our daily arithmetics, in weight and measure, in time and money, in counts and calculations seem to be closely associated with the great upheavals of history. Certainly, there is always a movement for reform and improvement even in ordinary times, but when life flows calmly human inertia is greater, small objections become magnified, and vested interests are more difficult to dislodge.

Wars and revolutions bring systems in contact with other systems. They must compete, be compared, and made compatible. Crises are apt to expose their inherent weaknesses. Besides, the revolutionary days in the history of mankind seem to make us all more susceptible to new ideas; a reasonable innovation is no longer an event of surpassing importance. They may even create a desire for change for change's sake, a feeling of relief in severing the ties with the past.

There is every reason to believe that the recent all-embracing war will bring us novel methods even in our daily commerce. Naturally, there will be no lack of proposals, some good, some bad, and some just plain crazy. There will be some which are reason-

able and advantageous, yet not too strange in comparison with our customary ways—in short, measures which stand a good chance of acceptance. Others may be systematically good, yet their advantages may be too small in comparison with the changes they entail. Finally, there will be an overwhelming number of proposals without any advantages whatsoever.

No one who belongs to the mathematical profession can avoid being asked from time to time to pass judgment upon a variety of arithmetical and metrological projects. It is perhaps a little surprising that one of the most common proposals from lay sources is the abolition of our old and comfortable decadic number system. Instead of counting by powers of 10, i.e., 1, 10, 100, 1,000, etc., some other basis number should be selected for this favored position. Some would give preference to 6 because the multiplication table would be so easy; others would count by 12 or dozens, since then it would be so simple to divide into 2, 3, or 4 parts; while still others would proceed by doubling 1, 2, 4, 8, etc. There are many claims for these proposals, and the mathematician is ready to admit that other number systems may occasionally be useful. However, there is no reason to believe that we shall ever be induced to give up our natural counters, the ten fingers. Our human relatives all over the globe count by tens to such an extent that other systems are quite exceptional. Some peoples count by scores; as a notable example let us recall the Mayans, and traces of such a vigesimal system are still to be found in the names of the numbers in many languages, as, for instance, in French and particularly in Danish. The twenty system is easily explained when one takes the toes to aid in counting. The dozen system may perhaps come in when a full fist is used to denote the number 6, so that two of them would be 12. Much more speculative are the theories concerning the origin of the Babylonian sexagesimal or sixty system, which is still with us in the division of our time as well as angles into minutes and seconds. The dyadic system with its repeated doubles or halves occurs in many instances in our weights and measures, or, to touch upon an illustration nearer the interest of some men, in the fractional quotations in the daily stock-market report. Such systems arise quite naturally in the search for the simplest division or multiplication procedures.

The transition from the Roman numerals to the Indian or Arabic numbers, as we still use them, is likely to remain the last real revolution in our arithmetic. The Roman numerals were most unsuited for extensive calculations, and an abacus, or reckoning board, was a practical necessity. Western Europe was brought in contact with the Indian "dust numbers" as used by the Arabs about A.D. 1100, largely through the influence of the Crusades. When compared with the Roman numerals they were so obviously superior in calculations that they won particular favor with the merchants and tradesmen who were instrumental in their spread all over Europe. As in the case of all reforms, there was considerable conservative opposition, and it took two centuries before the abacists, or Roman numeral adherents, had surrendered all main strongholds to the algorithmists, or followers of Mohammed ibn Musa Al-Khuwarizmi, the Arab mathematician whose works were the main sources on the new system. Not until the second half of the fifteenth century does one find Arabic numerals regularly on coins.

It is possible to predict that there will be two reform proposals which will be viewed with considerable favor by the world organization which will eventually be created to further international cooperation and coordination. The first of these is the perennial project of the universal use of the metric system, the second is the question of calendar reform.

The metric system has always been a scientist's system, in conception, in execution, and in use. The membership of the commission charged by the French National Assembly and by the French Academy with the theoretical and practical creation of the new system represented the cream of European science at the time of the French Revolution: Borda, Brisson, Condorcet, Coulomb, Delambre, Haüy, Lagrange, Laplace, Lavoisier, Méchain, Meusnier, Monge, Vandermonde. Lavoisier during his detention, shortly be-

fore his execution, asked in vain to be permitted to continue his work on the metric system under armed guard. The surge of science in the seventeenth and eighteenth century had demonstrated the desirability of having some common standard of measure. Instead of accepting some arbitrarily selected man-made unit, the scientific spirit craved a basis anchored in some invariable way in nature. There were at this time two main rivaling procedures for such a natural system, both actually used for this purpose, one based on the dimensions of the earth, the other derived from the length of a pendulum with 1 second's vibration. Nowadays there would probably be other suggestions, as, for instance, a standard based upon the wave length of some spectral line, or perhaps, in deference to the theory of relativity, a unit measure derived from the distance which a light ray travels in a second. Both the pendulum and the global measure were under serious consideration for the basic measure by the French Commission, but as everyone knows, the meter was finally fixed to be the ten-millionth part of a meridian from the Pole to the Equator.

This definition in itself is not the principal point in the metric system; the essential simplifications lie in the derivation of all other weights and measures from this single unit, the consequent decimal division and the systematic nomenclature. We may be a bit bewildered by the British coins, but this is a minor complication in comparison with the confusion experienced by anyone brought up under the metric system when confronted with our unsystematic divisions and extravagant array of units: inch, foot, rod, furlong, mile, hand, fathom, link, chain, pole, chord, perch, gill, pint, quart, gallon, hogshead, barrel, cask, peck, bushel (heaped or struck), troy and avoirdupois weights, grain, pennyweight, ounce, pound, quarter, hundredweight, ton, scruple, drachm, minim, stone, acre, and so on.

There was a strong desire for a scientific measuring system at the time of the French Revolution, but from a practical point of view the need now, in retrospect, appears to have been overwhelming. The standards of measure varied from province to province and from town to town in France as well as in most parts of Europe. For instance, according to one treatise there were in Switzerland 37 different feet, 68 different ells, 83 measures for grain, 70 fluid measures, and 63 weights. The French administration complained about the complications and obstacles created in the distribution of grain due to difference in standards and urged the adoption of a provisional meter before the final, more exact calculations could be completed. In addition, to the revolutionary spirit the old terms "Royal acre" or "King's foot" were clearly unworthy and obnoxious reminders of the past.

No reform, however desirable, is complete without its opposition. Even the judicious Montesquieu had complained previously: Is the pain of change always preferable to suffering the existing? He voices his sarcasm: There are certain ideas of uniformity which sometimes affect the great minds and invariably catch the smaller ones. It took nearly fifty years before the metric system was entirely victorious in France and a century before it became universal in continental Europe. In this century of expansion the metric system had to surrender one of its fundamental philosophical claims: to be a system anchored invariably in nature, not dependent on the arbitrariness of human choice. As time went on more accurate determinations of the lengths of the meridians could be made. The question arose here, as in principle for all natural units, whether the meter should be changed with each increase in the accuracy of measurement. It was decided that the answer should be no, the meter and kilogram should remain determined by the prototypes which one must hope are still deposited in the International Bureau of Weights and Measures at Sèvres near Paris. For practical measurements this agreement was, of course, without consequences.

Washington and particularly Jefferson were interested in the metric system and repeatedly urged the adoption of a systematized set of weights and measures for the United States. Jefferson had, however, a decided preference for a unit of length based on the pendulum, and this may in part ex-

plain why he did not follow up more vigorously his report of 1790 on a decimalized system. John Quincy Adams in his report to Congress in 1821 pays the following glowing tribute to the metric system: "This system approaches to the ideal perfection of uniformity applied to weights and measures, and whether destined to succeed or doomed to fail, will shed unfading glory upon the age in which it was conceived, and upon the nation by which its execution was attempted and has in part been achieved."

Despite such support of prominent men and influential groups the metric system, as we all know, is not in extensive popular use in this country, and it even appears doubtful whether any compulsory legislation stands any great chance of being passed within the next few years. Yet at present the metric system is legally approved, and, in fact, our standard units of measure and weight are based upon the metric prototypes, and there are indications that entering wedges are now being created for the metric system, particularly through the urgent demand for international coordination in many fields.

It appears to be easier to arrive at agreements on universal standards when international problems are involved. Local prejudices have less influence in such cases, and the need is often so obvious that a solution of some kind must be found. To cite an instance, no one who has gone through the nightmare of operating an automobile in a country with left-hand driving can avoid the feeling of danger which the situation implies. One emerges with a clear understanding that international navigation rules are imperative, on land, on sea, and in the air. To mention another example, the need for international medical standardization is pressing and fortunately rapidly progressing. It seems likely that all future international agreements in which weights and measures are involved will be made on the basis of the metric system. As early as in 1863 the metric standards were accepted by the International Postal Convention, and many other international organizations have since followed suit. But as far as the impulse on our daily measurements is concerned it may well be that the universal scientific acceptance of the C.G.S. (centimeter, gram, second) system in the long run will prove the strongest influence in familiarizing the public with the nomenclature as well as the other advantages of the metric system. Not only is science having a steadily increasing impact on education, but the numerous laboratories in research and educational institutions, in industry and manufacturing, form nuclei where the system is in constant use. The new U. S. *Pharmacopoeia* will contain only metric weights and measures, and it will bring the metric system to that great social institution, the drugstore.

It is to be expected that if this scientific influence should introduce us to the metric system it will lead us further and induce us to make changes in the readings in the few daily observations of nature which we still perform. For one thing, we shall probably then turn to the scientifically accepted centigrades on our thermometers. For another, it seems likely that the meteorologists, not to be confused with the metrologists, would convince us that we should read our barometers not in inches or centimeters of mercury but in millibars, as the international convention in weather observations now demands. The time may not be far off when we shall see them as facultative gradings on the commercial barometers.

The formidable scientific committee which was placed in charge of the organization of the metric system consisted largely of mathematicians and astronomers, and it would have appeared almost unnatural if they had not made an attempt at decimalizing the oldest of all our measuring systems, the Babylonian division of angles into degrees, minutes, and seconds. When one combines the fact that the meter is a one ten-millionth part of the meridian from the North Pole to the Equator with a division of the quadrant of the circle into 100° instead of 90° customarily, each latitudinal degree on the earth's surface corresponds to 100 kilometers. This would certainly be a simplifying element in navigation and in general estimates.

In the presentation speech to the French legislative bodies at the time of the completion of the metric standards, one finds the following quaint utterance on this subject:

"There is some pleasure for the head of a family in being able to say: 'The field which gives my children subsistence is such and such a proportion of the globe. To this extent I am co-owner of the world.'" Most modern mathematicians would be hesitant to express such an optimistic view on the interest of the general public in performing calculations. However, this decimal division of the globe immediately leads to a complication when applied to the Equator: the longitudinal degrees would no longer have their convenient relation to the change in time, 15° for each hour. But with the inexorable and irresistible logic of reformers and revolutions one proceeded to decimalize time. This reform was officially decreed, but it went too far even for the revolutionary spirit of the French. A few decimalized clocks were actually constructed, but they stand as memorials to a reform which died through public neglect.

Nevertheless, one can have no doubt that the decimalized and unified time and angle system would have been simpler and more harmonious than the ones now in use, but its advantages to the public as a whole are so small that we shall probably never see them reappear. But to indulge in some hypothetical thinking, should the astronomers come to the conclusion that a common decimal measure for time and angles would save enough labor to make profitable an investment in new tables, the navigators would be likely to follow suit and the time problem would again confront us. Laplace of the metric commission, "the Newton of France," took the consequences of his own proposal and used a complete decimal division of the angles in his master work on celestial mechanics. The system is still fairly common in France. Today's astronomers have contented themselves with a compromise by abandoning their "*partes minutae*" and "*partes minutae secundae*" for decimal parts of a degree in numerical calculations. Other systems of angle measuring may be useful, the mathematicians use radians and the United States artillery find their mils practical. The 24-hour clock will probably come into more general use through its adoption by the armed forces. In many European countries it has already been adopted officially; railroad and telegraph time are usually marked this way and clocks with 24-hour markings were fairly common before the war.

A common calendar for the world seems such a natural idea that any future league of nations is bound to bring up the problem for discussion. We may be a bit provincial in believing that our own calendar is almost universal and also that it is quite ideally constructed. In addition to our own Gregorian calendar there are the Chinese, the Shinto, the Mohammedan, and the Jewish calendars, all with numerous adherents; from India there are reported fourteen calendars of other types in actual use, and innumerable tribal calendars are spread over the world.

In all essentials our calendar is the same as the Julian calendar initiated by Julius Caesar in the year 45 B.C., with the Egyptian astronomer Sosigenes providing the necessary scientific foundation. One great innovation in this calendar was to make it exclusively dependent on the sun, leaving the moon entirely out of consideration; a second was the introduction of the leap year, which we still enjoy, to keep the year in step with the sun and the seasons. By this device the year was very nearly correct, only 11 minutes and 14 seconds too long. However, time will tell, and by the sixteenth century the year was ten days behind schedule and threatened eventually to get entirely out of its customary relation to the seasons.

After many hesitations, following expert advice from the astronomers, Pope Gregory XIII finally decided to move the calendar ahead ten days in 1582. To prevent similar developments in the future the leap year was dropped in all century years 1700, 1800, 1900, 2100, except when the century number was divisible by four as in 1600, 2000, etc. As one could expect, the move created the most violent opposition in certain quarters, notwithstanding a treatise of 800 pages of official explanations of the consequences of the change. When the reform finally came to England in 1752 there were even riots to bring back the lost eleven days, while some of the smartest guild members tried to obtain

eleven days back pay. The year is now a trifle too short and it has been proposed to make the years 4000, 8000, etc., leap years, contrary to the Gregorian rule. This would keep the year on an even keel for the next 20,000 years so that this side of our calendar should cause us no immediate concern.

There are, however, other aspects of our calendar which give us concern every time we handle our dates. For one thing it is inconvenient to have the weekday of any given date change from year to year. The Roman legacy left us with another disadvantage, the irregular lengths of our months. They are hard to remember, and the calculation of dates becomes complicated as we all know from sad experience. There are other anomalies in our calendar, which we perhaps do not notice so often; for instance, the first half of the year is three days shorter than the second.

The remedy is by no means obvious. The French Revolution, as we have seen, was possessed by the demon of decimalization and so proceeded to introduce a week of ten days. However, as de Morgan observes in one of his comments upon paradoxers, one can decimalize the Ten Commandments but not the Twelve Apostles. The number of days in the year is not divisible by ten, and no reason whatsoever is likely to make us abandon our seven-day week. When the 365 days of the year are divided by seven, there is an odd day left; consequently, if the week days shall repeat themselves on the same dates every year, there must be an extraordinary day which is not counted with the ordinary week days. This leaves us with 364 days to be arranged in the most satisfactory manner. Since this is exactly 13 times 28 days, one could divide the year into 13 months, each consisting of four weeks, or 28 days, which would repeat themselves in the same way throughout the year. Such a plan is certainly very simple in principle, and the 13-month year for a while enjoyed considerable favor. It was under discussion by the League of Nations and had strong backing, financially, for instance, by George Eastman of Kodak fame. There are, however, some drawbacks to the plan: The introduction of a whole new month would be difficult to reconcile with old contracts, and it would not be simple to divide the year into halves and quarters as we are accustomed to.

For these reasons the 13-month calendar has now largely been superseded by a new calendar proposal which its sponsors hopefully have named the World Calendar. The 364 days are now divided into four identical quarters, each of 13 weeks or 91 days. The quarter always begins on a Sunday. Each quarter has three months as usual, but to make the months as systematic as possible in their arrangement the first month in each quarter has 31 days and the two others 30 days. Here is the complete year:

THE WORLD CALENDAR

Every Year the Same

The year begins with Sunday, the first day of the week, and ends with an extra Saturday, the Year-End Day, which is the 365th day.

FIRST QUARTER

JANUARY							FEBRUARY							MARCH						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
											1	2	3						1	2
1	2	3	4	5	6	7	4	5	6	7	8	9	10	3	4	5	6	7	8	9
8	9	10	11	12	13	14	11	12	13	14	15	16	17	10	11	12	13	14	15	16
15	16	17	18	19	20	21	18	19	20	21	22	23	24	17	18	19	20	21	22	23
22	23	24	25	26	27	28	25	26	27	28	29	30		24	25	26	27	28	29	30
29	30	31																		

SECOND QUARTER

APRIL							MAY							JUNE						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
1	2	3	4	5	6	7				1	2	3	4						1	2
8	9	10	11	12	13	14	5	6	7	8	9	10	11	3	4	5	6	7	8	9
15	16	17	18	19	20	21	12	13	14	15	16	17	18	10	11	12	13	14	15	16
22	23	24	25	26	27	28	19	20	21	22	23	24	25	17	18	19	20	21	22	23
29	30	31					26	27	28	29	30			24	25	26	27	28	29	30

Leap-Year Day, June 31 or W, a World Holiday, an extra Saturday, follows June 30 in leap year.

THIRD QUARTER

JULY							AUGUST							SEPTEMBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
											1	2	3						1	2
1	2	3	4	5	6	7	4	5	6	7	8	9	10	3	4	5	6	7	8	9
8	9	10	11	12	13	14	11	12	13	14	15	16	17	10	11	12	13	14	15	16
15	16	17	18	19	20	21	18	19	20	21	22	23	24	17	18	19	20	21	22	23
22	23	24	25	26	27	28	25	26	27	28	29	30		24	25	26	27	28	29	30
29	30	31																		

FOURTH QUARTER

OCTOBER							NOVEMBER							DECEMBER						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
										1	2	3	4						1	2
1	2	3	4	5	6	7	5	6	7	8	9	10	11	3	4	5	6	7	8	9
8	9	10	11	12	13	14	12	13	14	15	16	17	18	10	11	12	13	14	15	16
15	16	17	18	19	20	21	19	20	21	22	23	24	25	17	18	19	20	21	22	23
22	23	24	25	26	27	28	26	27	28	29	30			24	25	26	27	28	29	30
29	30	31																		

Year-End Day, December 31, or W, a World Holiday, an extra Saturday, follows December 30 every year.

It seems difficult to improve on this arrangement; indeed, it appears to be a very fortuitous coincidence that it should be possible to find such a scheme which embodies within it almost all the improvements one would like to make with such a minimal deviation from our usual schedule. The date

for Easter remains the only element in our calendar dependent on the moon, and if the various religious groups could agree upon a fixed date the new calendar would repeat itself perpetually from year to year. There is no necessity to elaborate on the advantages of this calendar: it would simplify tremendously the problem of making schedules for every school and for every business and industry in the country. The new calendar has been very ably sponsored by the World Calendar Association, and since the reform is in the unusual situation of having the approval in principle by a whole group of countries it may not be many years after the war before we see it in effect.

The extra day which the calendar demands would be placed before New Year's day, and it might properly be named and devoted to some universal moral purpose: Peace, Liberty, Unity, World Understanding. In leap years there would have to be a second extra day to keep the schedule in order. I like to think of it as the Day of Reckoning.

THE FABLE OF THE SCIENTIST AND THE POET

A Scientist who had no use for flimflam set out one day with his mistress, Definite Purpose, for the City of St. Louis, which is in Missouri. Having taken numerous bypaths seeking for a shortcut, they finally were on the point of concluding that they had lost their way when they met a Poet going in the opposite direction.

"Have you lost your way, too?" asked the Scientist, noticing a sort of hesitant gleam in the Poet's eyes.

"No," replied the Poet, "I have not lost my way because I wasn't going anywhere in particular. I am just wandering about looking at the sky. I have been watching the clouds until my neck is stiff. I think I shall write a poem about clouds. By the way, who is that woman?"

"Oh, her? She's a friend of mine, but I am seriously thinking of dropping her off at East St. Louis. She is getting to be a terrible nuisance and keeps telling me that if I had listened to her advice we wouldn't have gotten lost. She keeps asking me where the hell I think I'm going."

"Well," said the Poet, "it's none of my business, of course, but if I were you I'd get rid of her. Why don't you ditch her and stay here awhile with me and tell me about clouds. There are several questions I'd like to ask you about them. But that woman! She gives me the willies. If she can't keep you on the right road, what good is she? And besides, she does not seem to me to possess that air of beauty that one should desire in one's feminine companions."

"I know," said the Scientist. "Sometimes I agree with you, but shaking her off is not so easy as it seems. And so, since I must apparently choose between you, I'm afraid I must forego the dubious pleasures of meteorology and the company of an uncertain Poet in favor of the lady here, who, though she is something of a termagant and frequently causes a problem in regard to obtaining a hotel room, has on numerous occasions saved my professional face and once even saved my life."

"A frightfully long sentence," said the Poet, "but I see what you mean. It must be miserable, though, to be beholden to such a repulsive creature. It has been awfully nice knowing you. Must you go?"

"Yes," replied the Scientist, "I'm afraid we must. But do you happen to know which road we should take to get to St. Louis?"

"St. Louis is so far away," answered the Poet. "Why don't you go to Minneapolis, Minnesota, instead? It's a lot nearer and besides has a much more mellifluous name."

At this, Definite Purpose, who up to this time had taken no part in the conversation, swore a mighty unsanctified oath and grabbed the Scientist firmly by the arm, and together they went off down the road, almost running, leaving the Poet alone and a trifle bewildered.

Moral: There are worse things than being lost while going to St. Louis.

—Paul H. Oehser

THE SCIENCE CORE IN LIBERAL EDUCATION*

By A. J. CARLSON
UNIVERSITY OF CHICAGO

As THE natural sciences provide our only reliable understanding of man and of the universe, these sciences have gradually been incorporated as part of our liberal education. The sciences of physics, chemistry, biology, and medicine have given new implications to the old sayings: "know thyself"; "the proper study of mankind is man." But it is not true that the natural sciences dominate (some say destroy) liberal education in America today. If the nearly 200 colleges and universities of 16 midwestern states studied by me three years ago are at all typical of our nation, the natural sciences in our colleges make up only about 20 percent of the college faculties and college teaching budgets. I can only express my grief and regret that so many colleagues do not secure information on this question before they talk or write. We, the teachers, should speak by the card. And according to my best information and experience the natural sciences, or anything worthy of the name science, do not dominate the high school curriculum of our nation either.

Owing to the imperative needs of technology, this war has led to some fears, confusion, and debate both as to our alleged educational failures and dry rot of yesterday, and as to the danger of greater educational errors tomorrow. In much of this debate we are putting the emphasis in the wrong place; on the *plan* or the *system* instead of on the *teacher*. To be sure, there is technology without science, but there is no science without some technology. Why fear *skill* in any field? There is technology even in philosophy, in the humanities, and in the social studies. This war has fostered another delusion. We think we are going to have tomorrow not only "one world," but a "new world"! Hence, the tried and true in yesterday's liberal education will not apply to tomorrow. Yes, a new world, populated by the same old genus *Homo*. For history and anthropology reveal that man changes very, very slowly, considering the span of our race. It seems clear to me that we shall come out of this war with the same old brain, the same old struggles to survive, essentially the same old mores and values in human relations and in the pursuit of happiness. Here are a few recent samples of this futile and unfortunate debate:

In his recent book *The Rebirth of Liberal Education*, a study financed by the Rockefeller Foundation, Dr. Fred B. Millett makes the charge that science and the scientific method are the most dangerous foes of the humanities in our liberal education program. President Hutchins appears to voice the same myopic views when he charges that "specialism, which has wrought such wonders in scientific investigation, has promoted the extinction of liberal education. . . . The forces of specialism are constantly whittling down the program of liberal education and deprecating it." But President Hutchins knows, or should know, that specialism, in the sense of the trivial as opposed to fundamentals, is not confined to the natural sciences. There is plenty of specialism and the trivial both in the humanities and the social sciences. And there is little progress in the old pastime of the pot and the kettle. None of us can always be sure that what first appears trivial in the natural sciences will remain trivial. The failure of bacteria to survive in close proximity to certain moulds looked trivial at first, but few informed people would label the discovery of that initial fact *trivial* today.

Professor J. Duncan Spaeth of Princeton University is on the same beam when he says: "The eclipse of the humanities as a result of mobilization of education for total war is but the culmination of tendencies and drifts that have long been operative, and is a symptom of the deep *infection* [italics ours] of our modern, and especially our Western world,

* Abridged from Bulletin 1 of the Association for General and Liberal Education.

with a mechanistic and materialistic interpretation of the nature and source of *power*. It is the victory of the 'law for thing,' over the 'law for man'." But man is also "a thing," subject to the forces and laws of nature. I regret to note that Dr. Spaeth is in the poorly informed group who insists that the natural sciences *dominate* modern liberal education. This is simply not the fact. And there does not exist that clear and sharp antithesis between the natural sciences and the humanities outlined by Dr. Spaeth: "Science advances by experiment, the humanities build on experiences. Science . . . creates the knowledge that is power; the humanities . . . create the power that is character. . . . The humanities look backward, the physical sciences look forward." Nor can I agree with Dr. Spaeth that "the humanities are the only efficacious antidote to a narrow nationalism and cultural isolationism." The scientific method is universal. Biology and anthropology have established the essential homogeneity of the present human race. The sciences of medicine, health, and disease cannot (or should not) be confined by political boundaries. But I am in complete agreement with Dr. Spaeth when he says that both the sciences and the humanities are necessary in "a complete and generous education." However, when is even a "generous education" *complete*? Granted that some teachers in the natural sciences, as well as some teachers in technology, stay too persistently in their special ivory towers and are relatively ignorant of essentials in other fields of human needs. Granted also that a few very competent men in the natural sciences (especially in the stronger colleges) focus even their elementary courses in the direction of specialization rather than on the needs of liberal education for all citizens. The most we can make out of these facts is myopia of a few individual scientists. These facts do not warrent the above sweeping condemnation of science and the scientific method. I cannot agree that training to "carry your own knapsack" is entirely foreign to liberal education. I was trained in my youth to coordinate the hand, the eye, and the ear with the brain, to do some tasks with speed and accuracy (farming, carpentering) necessary for living. That training (plus the "classical course" in the American college of 50 years ago) does not appear to have retarded the quest or seriously damaged my mental processes. It may be questioned whether science and the scientific method can make the greatest contribution to liberal education without some technology, a minimum of individual laboratory and field work. But I fail to see that such laboratory and field experience is an enemy of history, sociology, or the fine arts. The goal of the natural sciences is the *understanding of man and the universe*. If the goal of the humanistic educational disciplines in liberal education is the *evaluation of values*, I for one fail to see any antagonism between them. Men and women of tomorrow need both. It would be more to the point to put the emphasis on cultural teachers rather than on cultural courses. Any real evaluation of "values" calls for some understanding of man. The understanding of man and the rest of nature should by itself create some "values."

WHAT is, or should be, the minimum core of science in liberal education? If we can find it, if we can agree on it, have we the men and the means to make it effective?

1. I think most educators will agree that this core must include: (a) mastery of the scientific method, the principles of experimentation and controls in experience; (b) the fundamentals of human biology in health and disease; (c) the fundamental forces and processes in the universe—all these things, not on the basis of the guesses of today or the philosophies of yesterday, but derived through application of scientific methods.

2. On the college level, as well as in the high school, the time required to attain these goals will vary with the teacher and with the student. But I think that this science core would not greatly crowd the offerings in the humanities, especially if the science teachers could inspire their students to work; that is, to use all their mental abilities to the utmost. It should be equally clear that these goals may be successfully approached by different plans and set-ups in different institutions. The plan or plans are of secondary impor-

tance, the teacher or teachers are of first importance. The general science courses for all college freshmen have gotten results in the University of Chicago. But the same plan, with different teachers, has failed in some colleges. It is clearly up to the genius of each college faculty. College administrators should not try to impose on the faculties any plan by fiat. The teacher must be convinced that the experiment is worth trying. Then, and only then, does it become an educational experiment.

3. In a recent 62-page report on the education problem of the world today the British Association for the Advancement of Science point out that science in general education should not be as strictly compartmentalized as are the natural sciences in the training of specialists and technologists. "The study of natural science [in general education] must be wider than that of the specialists' science schools; e.g. chemistry and physics should be taken together as part of 'physical science,' and general biology in place of separate treatment of zoology, botany, and physiology." This is essentially the type of courses in the Physical and the Biological Sciences required of all freshmen students in the University of Chicago during the last 15 years. I agree with our British colleagues that we do *not* have enough teachers trained to give such courses adequately. But I cannot agree with them when they say that because "few teachers in history, economy, and language have even a passing acquaintance with the natural sciences and the scientific method," and "few scientists have a good grasp of social problems" students in the humanities should not be compelled to take courses in the natural sciences, and students in the natural sciences should not be forced to take courses in the humanities and the arts. Educators who wait for utopia are obstructing progress. When we are sure of the goal, we can try for it, even with the aid of crutches.

4. So far I have spoken as if the liberal education of our fellow citizens was primarily or exclusively a concern of the colleges. This is, of course, not the case. This education at the high school level is even more important than at the college level, for the high schools reach more students. And as to the mental maturity or immaturity of our high school population, I am certain that a large part of the high school students can master the above science core had we the facilities, the vision, and the men and women who could really teach it. I speak not without experience on this point. For more years than I care to state I have endeavored to teach (let my students say how effectively) the dynamic biology of man to (a) college freshmen; (b) medical students; (c) graduate students. When you get your students' real attention and interest, their mental capacity is equal to the task at any and all of these levels of mental development. Of course, I admit that the dynamic biology of man has the advantage that, here and there, it contacts and clarifies the student's own experience. I have always felt a responsibility to college freshmen in this field. For without a clear understanding of man in health and in disease even college-trained men and women are but "sitting ducks" for the thousand and one varieties of medical and social quackery that feed on the ignorant.

5. The college teacher, like other people, can readily become a creature of habits and a worshipper of the past, including the sacrosanct liberal education curriculum on which he may have labored for a quarter to half a century. Science has indeed disturbed the traditional humanities, not so much by crowding the curriculum as by questioning ancient and easy answers and interpretations. Science bows to no man, not even to the "hundred great books" of the past. Yes, science is an iconoclast, a disturber of faiths and dreams, a challenger of nostalgia. But science is a product of man, and science changes significant parts of man's environment faster than does raw nature. Science creates new problems important in the lives of all the people. The science core in liberal education must provide an understanding of these changes and problems lest we perish.

AN ANTHROPOLOGICAL BIBLIOSYMPOSIUM*

MAN AND HIS WORLD

By W. M. KROGMAN

DEPARTMENT OF ANTHROPOLOGY, UNIVERSITY OF CHICAGO

Mainsprings of Civilization. Ellsworth Huntington. 660 pp. Illus. 1945. $4.75. John Wiley and Sons, Inc., New York.

TAKE equal parts of the *Pulse of Asia* (1907), *World Power and Evolution* (1919), *The Character of Races* (1924), *Civilization and Climate* (1924), *Season of Birth* (1938), add dashes of many other books and shorter articles, mix well with nearly fifty years of keen observation and speculation, and season with an intriguing ability to fit curves to theory and vice versa, and you have the present volume, a stimulating and at times heady concoction.

The book is in three major parts: the background of civilization; heredity; physical environment and human activity. I am going to discuss these parts in order and then shall attempt an evaluating synthesis.

Evolution has been guided by three principles: 1) a basic evolutionary force; 2) innate qualities of the organism as determined by heredity; 3) the physical environment (p. 35). The latter is extremely complex for it includes the factors of climate, distribution of plants, animals and men, demography, agriculture, diet, housing, industry, transportation, trade, inventions, machinery, science, education, art, religion, crime, war, politics, and philanthropy (p. 225). It follows, therefore, that Huntington is ultimately concerned with biosocial evolution. On the purely organic side "the tendency of evolution has been to develop some form of life for every environment which is not prohibitively cold, dry, or otherwise impossible" (p. 22). This has been facilitated by three things: the constancy of the temperature at the Earth's surface; a ready and balanced supply of water; and an endless source of free oxygen. Correlated with this are ten factors of life itself: size of planet, density of planet, distance of planet from the sun, shape of the planet's orbit, speed of the planet's rotation, length of the planet's day, degree of the planet's cooling, size of central sun, developmental stage of central sun, degree and periodicity of variation in sun's rays (pp. 19–20).

All these ultimately set the stage for vertebrate evolution. Then came a series of physical and climatic changes. In the Paleozoic, uplift gave rise to swiftly running waters which in turn demanded an axial stiffening—so a flexible backbone developed. In the Permian, aridity gave rise to lungs, warm blood, speed of locomotion, and higher metabolism. Later, descent from trees gave survival value to primate brain and hand (pp. 23, 26). Man was born and of this fact we are told that "since *H. sapiens* spread widely over the earth he has experienced no radical biological change" (p. 33).

In his treatment of organic evolution Huntington is quite orthodox. He follows the conventional sequence emphasized by paleontologists. But for him physiographic and climatic changes are the impelling forces in sequential progress: if there is a change on the earth's surface or in the earth's atmospheric envelope, there is a corresponding change in the earth's organic life.

But man is more than an instinctive animal, he is a cultural being as well. Accordingly, the basis of this entire volume is found "in the fact that *H. sapiens* is the most advanced product of organic evolution and modern civilization the most

* With this issue SM publishes its first "bibliosymposium." The editor coined the word and we think that it describes accurately the objective we had in mind; namely, to present extended reviews of a group of books on the same subject. The atomic bomb, resulting from unprecedented activity on the part of the physical scientists, brought military victory to our side. It now remains for the social scientists to match the versatility of their colleagues to ensure our winning the peace. As this bibliosymposium well testifies, the students of the science of man have not been idle. We have at hand the basic fundamentals of the relationships of intersocietal living; now we must strive to write them into the peace and make them work.

The project represents an experiment for SM. Presentation of another depends on a number of factors. First, there must be a group of books on the same general subject, published within a reasonably close time. Secondly, there is the matter of space, for SM always has a backlog of principal articles that must be published. Finally, there is the question of whether or not a majority of the readers want it—and on this subject we hope that we may have an expression of opinion from a large number of SM subscribers. A limited number of reprints will be available. Requests should be directed to the Book Review Department.—T. J. C.

advanced product of human progress" (p. 14). So we come to *culture*, which is defined as "every object, habit, idea, institution, and mode of thought or action which man produces or creates and then passes on to others, especially the next generation" (p. 7). For Huntington the evolution of culture is due to the exigencies of the environment, and, moreover, it develops in a certain sequence. "Man appears to be so constituted that, wherever the physical environment permits, he will in due time evolve such ideas as the raising of cereals, the taming of animals, etc.," and "a similar spontaneous development occurs along more abstract lines" (p. 2).

After culture comes *civilization*. "Advances in human culture in their turn modify both physical environment and heredity. The ultimate result is civilization" (p. 42), which "begins when people learn to practice agriculture, live in permanent communities, establish a definite form of government, and acquire the art of writing" (p. 7). But civilization is not inevitable. Many cultures do not make the grade, so to speak. Civilization entails a twofold selective process, which 1) "eliminates people who fail to reach a minimum level in certain innate qualities which are essential to preservation," and 2) "eliminates customs and ideals—mores—which tend to cause a kith to die out" (p. 172). This selective process, in turn, gives a balanced blend of physical environment, selective heredity, and a socially acceptable set of concepts concerning material possessions, customs, and ethical standards.

The development of civilization and the rate of its progress depend "upon the degree to which the geographic environment in all its phases is appropriate to the stage of culture attained" (p. 612). It depends also "upon health and upon the vigor with which people use their innate capacities and cultural advantages" (p. 612). Huntington defines vigor as "the kind of clear-eyed alertness and eagerness for work which one feels when in the pink of health," for "good health and high civilization obviously go together" (p. 237). Health and vigor are due to: 1) innate biological endowment; 2) a favorable physical environment with respect to climate, food, and disease; and 3) a culture high in medicine, nutrition, sanitation, hygiene, and transportation. There are other biosocial factors: "The tendency of the human species to mate at all seasons seems to be one of the cornerstones of civilization" (p. 32); and, "It is generally agreed that the family is the basic unit of society" (p. 32).

Two of the most potent factors in the emergence and progress of civilization are climate and temperature. Civilization arose first in latitudes 25° to 35°, and if within 25° of the Equator it arose on temperate plateaus (5000′–7000′) or cool seacoasts (p. 269). Examples of tropical civilizations are found in the highlands (the Aztecs in Mexico, the Yemen in Arabia, the Zimbabwe in Rhodesia); the cool west-coast areas (Inca in Peru); and the warm, rainy, forested lowlands (Singhalese in Ceylon, Cambodia in Indo-China, Java, and the Maya in Yucatan and Guatemala). But even then Huntington feels that "it is probable that migration was at the basis of all tropical civilization" (p. 398).

Huntington administers the coup de grace to Mackinder's *Geopolitik:* "Who rules Eastern Europe commands the Heartland, who rules the Heartland commands the World-Island, who rules the World-Island rules the World" (quoted on p. 199). Huntington observes that the peoples of the Heartland have had a great effect on history owing to their "innate character and closely knit democratic social system, which normally develops when the same kith resides for many generations on steppes or mountains where the pastoral mode of life prevails" (p. 203). Huntington concludes that the Heartland is no longer strategically important owing to human mobility.

We may now turn to Man, himself, to whom "the laws of biological evolution still apply . . . as forcibly as to amoebas or apes" (p. 608); or, again, "We may be certain that the same great principles which have governed organic evolution for a billion years or more will still prevail. Selection will assuredly eliminate certain types of peoples and also certain customs" (p. 609).

Man lives in groups and he moves about in groups. Therefore *migration* is an important factor in the emergence and diffusion of civilization. Huntington's major thesis here is the selective nature of migration—he believes in Sandburg's, "The cowards never started; the weak ones died on the way." He has this to say: "When a single migrating group is taken by itself, it seems probable that those who migrate farthest, or to places especially difficult to reach, or requiring difficult adjustments to new conditions, are likely to be the ones most highly endowed genetically as well as culturally" (p. 75); to which he adds, "People of diverse social levels and abilities migrate in different directions and to different degrees" (p. 93). Several examples of selective migration are given, especially of nomads, when the Asiatic Chantos of the Tarim Basin ("the essence of mediocrity") and the Khirghiz of the neighboring steppes are compared. "If temperamental tendencies are hereditary, as most assuredly they are, it seems almost certain that prolonged biological selection must have tended to

intensify innate qualities which give nomads unusual ability as soldiers, organizers, and rulers" (p. 179). He also compares the Hakka, in the mountains north of Canton and west of Foochow, with village-dwellers of North China, and concludes that here again is illustrated "selective migration which separates people of the same race into an uncommonly competent group far away from the original home, on the one hand, and a group, little above the stage of morons, on the other" (p. 185). Huntington is a firm believer in the role of superior peoples in civilizational development. He now develops the theme of these highly endowed peoples with "innate" abilities.

The answer to this problem is found in *kiths,* a useful concept developed by Huntington, a term devised (after rejecting "natio-racial" and "ethnic") for "groups of people smaller than races and often derived from a mixture of races" (p. 102). Kiths are defined as "groups of peoples with a similar culture and language and with the custom of intermarriage" (p. v): or, alternatively, as "a group of people relatively homogeneous in language and culture, and freely intermarrying with one another" (p. 102). The idea of the kith "recognizes that biological inheritance is a real and important factor" (p. 214). There are *microkiths* (as the royal families of Europe, the patricians of Rome, the aristocracy of ancient Greece) and *macrokiths* (as the Rumanians, the Prussians, the English) (p. 220). Evidently kiths are both sociopolitical and national. The latter are, throughout the book, the most frequently referred to: Jews ("no other kith has so persistently produced great leaders") (p. 154), Icelanders, Newfoundlanders, Puritans, Junkers, Quakers, Mongols, Sicilians, Picts, Angles, Normans, Parsis, Hakkas, Hittites, Spartans, Highlanders (in Scotland, Kentucky, Nepal, Kenya), Walloons, and the Portuguese Negroes of Brazil. This is a heterogeneous assemblage, running a religio-socio-politico-militaristic gamut.

Huntington believes the kith to be the potent force in cultural origin, diffusion, and survival. The Puritans are an excellent example of this. "If the selective forces are strong enough, and if the people who are selected are sufficiently isolated, the results of selection by migration may persist with amazing strength for centuries" (p. 126). A number of Puritan names, 588 of them, were selected "because of their dominance in southern New England after the Revolution"; they "represent the racial stock of 'kith' . . . which originated for the most part from 1630 to 1642" (p. 102). Of these names three were, together with four widely used English names, traced in *Who's Who,* the *Encyclopaedia Britannica,* in credit ratings, and in criminal records and public relief records. The ratios of the three "Old Colonial" names to the four used for comparison were as follows: *Encyclopaedia Britannica* 16.8, *Notable Americans* 10.5, *Who's Who,* 6.3, inventors 1.8, criminals 0.6, on relief (in 1933) 0.4 (p. 122). It was concluded that "these facts . . . all suggest that hereditary mental traits, as well as cultural conditions, enter into the differences among our various types of names" (p. 122). He goes on to state that "crime and chronic dependence on relief . . . are often significant of innate weakness as of misfortune" (p. 105). One is reminded of Hooton who regards criminal behavior as evidence of "biological inferiority."

While Huntington stresses *kiths* as a basic unit in civilization, he still refers to *race,* and usually does so in a special manner, almost always referring to an innate character. Thus on p. 43 he speaks of the "innate mentality of a pure Negro population in Africa;" on p. 44 of "innate racial character;" on p. 155 he says that "the process of selection depends upon mentality far more than upon the external physical traits on which races are based;" and on p. 37 he states that "we need exact knowledge of the innate qualities of races, and especially of nations and social classes." Finally Latimore (p. 170) is quoted regarding the North Chinese and the Mongols: differences between them are not so much physical, as in "stance, movement, expression, manner . . . not differences in physique itself, but of the life within the physical structure . . . these intangibles, which belong to outlook, culture, feeling, and the way of life, establish a cleavage." All these references are quite acceptable, but the interpretation begins to give one pause: "Human society is so constituted that competent people tend to rise to the top, thus creating social stratification" and "this stratification is associated with differences in innate capacities" (p. 147); "Want, misery, disease, and backwardness are favored by the existence of people with low innate capacities, or by the presence of too dense a population composed of people with ordinary capacities" (p. 224). This oft-repeated faith in "innate capacities" (biologically and culturally) may be used as a step towards a claim of national or racial superiority. Huntington himself doesn't make such a claim. In fact he says "although race has played a great part in history, the moving force has been the *idea* of racial superiority, rather than any actual differences other than those due to environmental or to dominant kiths" (p. 221). This is well and good, but the stated or implied supremacy of "innate qualities" is certainly an *idea* that may be taken up by racists!

Human social behavior is profoundly influenced by the *seasons,* which "have exercised a great effect upon the type of culture which has grown up in various parts of the world" (p. 311). Obviously agriculture, affected doubly by geography, per se, and by seasonal fluctuations, is very important in civilizational progress. Other phases of man's behavior are also influenced by the seasons: disease and death are most prominent in February; mental alertness is at a maximum in March; insanity, suicide, and sex crimes are at a peak in May and June; irritability, violence, and rioting take precedence in June; inclination to physical effort is at a maximum in October and November (pp. 358, 365, 368). If you want to live longer get conceived in June, born in March (p. 319). If you wish to achieve fame arrange to be born in February, or even January (p. 322). Of the latter two desirabilities Huntington suggests "that mankind still inherits an unknown mechanism which originally helped infants to endure summer heat, provided they were born in early spring" (pp. 273, 323).

There are undoubtedly certain physiological stimuli and responses in seasonal change so that individual reaction—and even group reaction as the summation of component individuals—may affect social behavior. But this is not, cannot be all. One must look deeper into the structure of the social organization. Huntington admits this, but he himself does not give social structure enough weight.

Climate in its entirety is a very potent factor. Huntington speaks of the "coldward and stormward" march of civilization (p. 405). Specifically, "in the last several thousand years the center of civilization has shifted from warmer to cooler areas, and from quieter to stormy areas where atmospheric ozone and electricity are at a maximum" (pp. 528, 547). "In the climatic pulsation of historic times a major feature appears to have been variations in the movements of polar and tropical air masses" (p. 375). In the presence of a storm there are changes in air pressure, air movement, water content, temperature, amount of ultraviolet, ionization, and atmospheric ozone and electricity (pp. 527–528). These changes record themselves upon human behavior, and Huntington cites as an example the period A.D. 1250–1450 when the amount of storminess increased, and extremes in weather occurred (pp. 505–506). As a result this "was a time of special alertness, initiative, and originality in most of Europe" (p. 599).

There is another phase that is deemed important; namely, *temperature.* The optimum is 70° F. in humid regions, 80° F. in dry regions (p. 268), with an all-around optimum of ca. 65° F., day and night (p. 273). Huntington makes one statement of special importance to the physical anthropologist: "The essential uniformity of the reaction of all races to temperature is altered only slightly by a few racial differences which may be interpreted as incipient biological means of protection against heat or cold" (p. 267). He goes on to cite the Eskimos and Tibetans who are stocky, with a layer of fat; the East Indians who are slender, with relatively large surface areas; the African Negroes who have developed many sweat glands and deep pigment. The adaptive morphology of the Eskimo and Tibetans and of the East Indians suggests Sheldon's endomesomorphy and ectomorphy, respectively.

Huntington feels that *diet,* closely related to climate and the weather, is very important: "the diet that has prevailed for generations is one of the major factors in determining the character of nations and kiths, and in settling the fate of wars and the rate of human progress" (p. 431). He extends this theme by stating that "the ideal diet . . . must be essentially that to which man became adjusted during his long and slow evolution" (p. 433). Such a diet, he contends, must be eaten in a fresh condition, must possess variety, and must grow in natural soils, little deteriorated by long or excessive cropping. The relation of diet to growth is a factor well known to students of child development. It follows, then, that if the physical growth of the population is facilitated by diet, the adult physique must be correspondingly influenced. We can agree that diet and civilization are correlated.

We come, finally, to the problem of *cycles* in human affairs. Such cycles are repetitive, rhythmic, and periodical. Hence they have predictability. Huntington is inclined to ascribe them basically to sunspots (following Tchijewski); these solar phenomena are reflected in increased electrical activity in the sun, which in turn affects atmospheric ozone and electricity. "There is scarcely room for doubt that through some electrical process sudden disturbances of the sun's atmosphere are associated with a well-defined influence upon man's health and psychological reactions" (p. 516). There are a number of cycles: 1) a 41-month (3.4 years) cycle which predominates in business as seen in the stock market (Dow-Jones) and in prices, production, and sales (Beveridge, Hoskins, Dewey, etc.) (pp. 463, 468): 2) a 7.5-year cycle or multiple thereof, seen in wheat prices, 68 years (Beveridge); sunspots and other electrical cycles, 22 years; weather in Europe, 22 years (Brunt); weather generally, 46 years (Abbot); rain and

flood, 90 years; cotton prices, 68 years (Dewey); Nile floods, 66 years (Brooks); and varves in Lake Saki, Crimea, 67 years (p. 461); 3) a nine-year (9.2 years) cycle, influenced mainly by atmospheric electricity and centering principally upon business phenomena (p. 476); 4) a 9.7-year cycle influenced mainly by atmospheric ozone, and centering upon animals and physiological phenomena, e.g., the 9.6-year cycle in chinch bugs and the ten-year cycle in caterpillars, salmon, and grouse (p. 488); 5) a 35-year cycle enunciated in 1891 by Bruckner: "the weather of Europe varies definitely in cycles with an average length of about 35 years" (p. 455); to which Huntington adds that since A.D. 1700 insect pests in Europe have had a general maximum at average intervals of approximately 36 years (p. 456).

These five cycles—3.4, 7.5, 9.2, 9.7, and 35 years—are not so clear-cut as one might always wish. They may well, at times, be either fractions or multiples of one another. There are climatic pulsations, cyclical in nature, but their essential independence of one another is not clearly demonstrated. There is no absolute proof that they may not represent an almost continuous series of exacerbations and remissions.

In the foregoing pages I've presented Huntington's major theses at considerable length. I've quoted him extensively, to the best of my ability. I've done so fairly, not ripping a quote from its context so that I've neither misrepresented Huntington nor (mis) quoted him to offer ideas of my own. I read this book literally line-for-line. It is good, well done, it is stimulating—and at times it is irritating. I wish, for example, that he had not said this: "Regardless of rain or shine, people's impulse to draw books from the library is subject to constant fluctuations in harmony with the coming and going of the tropical and polar air masses which bring storms" (p. 375). (I said to myself, "Hm, I'll wager *Forever Amber* was inspired by a tropical air mass"). I reacted to some of the treatment of the data regarding cycles by thinking of the story of the dear old lady who regarded the number 7 as very important in the Bible; when the Twelve Disciples were pointed out to her she triumphantly rejoined, "Yes, but 7 and 5 are 12, aren't they?" When Huntington refers to the reproductive cycle and basic diet as reminiscent of ancestral history, he subscribes once more to innate qualities. I have the feeling that he believes in biological and cultural superiorities; that's O. K., as long as we accept these as optima for *all* peoples; selection is operative, but we cannot permit it to be discriminatively so. Whether he intends to or not, Huntington gives aid to those who believe in "innate" racial biological and cultural superiorities.

The concept of *kith* is an important contribution to anthropological thought. In a sense it corresponds to Boas' "family-line type," and the German *Gautypus* and *Berufungstypus*, but Huntington develops it into a fairly consistent, workable concept. All told, this book should be read—carefully, painstakingly—by anthropologists of all "schools" of thought. Some will yelp vigorously at his causative correlation between natural phenomena and culture. But I think that one may react as vigorously to "All Culture from Climate" as to "All Culture from Culture." To me the answer is somewhere in between—I am not an appeaser, or a middle-of-the-roader. As a human biologist, I am skewed in Huntington's direction.

What I've said above may well represent an individual reaction colored more by my own fears and doubts than reflecting the true nature of the book. But there's one final criticism I would make; namely, that Huntington makes many claims or deductions concerning human heredity that are not, in fact, borne out by our present scanty knowledge. He uses raw statistical data from many and diverse sources and fits them to a series of curves that usually have the time element as basic. The curves may well be—and often are—similar, but the conclusion that the diverse data are related by virtue of common causative factors (usually climatic) does not necessarily follow.

But I do come to this conclusion: Huntington *has* something. We cannot accept him without challenge, or reject him without trial.

ANTHROPOLOGY AS AN INTEGRATING SCIENCE

By WILLIAM N. FENTON

BUREAU OF AMERICAN ETHNOLOGY, SMITHSONIAN INSTITUTION

The Science of Man in the World Crisis. Edited by Ralph Linton. 532 pp. 1945. $4.00. Columbia University Press, New York.

GETTING a group of authors to deliver papers written toward a common objective, but from varying points of view, has always been difficult. Ralph Linton, nevertheless, during the past year managed to find among the busy social scientists of the nation the makings of a symposium on the Science of Man; he assembled the papers, con-

tributed two of his own, and he got the Viking Fund to underwrite publication of the volume. This was no mean accomplishment considering that many productive scholars were cut off from writing by restrictions, others were in the armed forces, nearly all were diverted from regular work, and all were in some way disturbed. The book that the group has written is not a plan for the present crisis; instead it attempts to acquaint planners with discoveries and new techniques from the frontiers of research on man and his society. Let us hope that it may not take a generation to accomplish the purpose that this volume intended. In fact, some progress has already been made in that direction. When one hears the radio voice of the Chief Executive employing the terms "race, language, and culture" in their anthropological sense in his closing speech to the San Francisco Conference, one realizes suddenly that the layman is already somewhat familiar with a terminology that implies an objective approach to human relations.

In groping toward the concept of a unified world society, the intelligent layman for whom the book is intended may fairly ask, "What has the student of man got that others lack for understanding the present world crisis?" The answer might be, "A way of looking at men and events, a body of principles, and some techniques of study, which this volume attempts to demonstrate." Then the layman will want to know how well the book accomplishes its purpose.

The twenty-one essays composing this volume fall into several categories: general scope, the biology of man and related values, culture as science, culture and the scientific world view, applications, and special considerations. Naturally, there are lacunae, as there are bound to be in any symposium.

The general reader cannot fail to gain a fair conception of "The Scope and Aims of Anthropology" by reading Professor Linton's introductory chapter. Here anthropology makes a bid for the key position in "a new synthesis of science, especially of those sciences which deal with human beings and their problems." Whether anthropology succeeds as an integrating social science depends in part on the quality and outlook of its personnel. In recent years its disciples have differentiated into specialists who no longer profess anthropology but one of its various branches which Linton defines. Beyond a fundamental split between students of man and students of his works there are all too few good general anthropologists in the present generation. Few can command any more than one subscience within a general field and usually but one corner of a larger area. The modern anthropologist, if he is in the cultural field, is an archeologist, an ethnologist, a social anthropologist, or perhaps a linguist. Seldom is he two of these. Considering the wartime activity of linguists as teachers of languages in Army area and language programs, we cannot agree, however, that "linguistics is, at present, the most isolated and self-contained" subscience of cultural anthropology. Likewise, the cultural anthropologist has been called on to serve on a team of specialists who would control the civilization of a great area. This chapter answers the question "What is anthropology and what are its possibilities?" The serious student of other fields, seeking to knock down the barriers between existing disciplines, may find here hope and understanding of how anthropology may function in a truly integrated science of man. Judging by the contributors to the symposium, Linton has already succeeded in enlisting coworkers from other fields than anthropology.

Three papers treat the relations of biological man to his society. Dr. H. L. Shapiro (American Museum of Natural History) deals with a limited portion of human biology, clarifying "some of the problems that face human biology even though the answers are lacking"—the nature of racial differentiation, patterning and variation in man, race as reality, the taxonomy mania. How will the dysgenic influences of war affect human population? How will talent reassert itself in war-torn populations?

Of the three papers, "The Concept of Race," W. M. Krogman (University of Chicago), has especial significance for both student and layman. The former finds a redefinition of "breed, race, and stock"; the latter must learn: "that biologically there are no fundamental physical differences in all stocks and all races; that biogenetic potentials are shared equally by all stocks and by all races." . . . "Biological equality!"

That race differences are mainly social differences Otto Klineberg (Columbia) maintained in a little book some years ago. His chapter here on "Racial Psychology" summarizes recent evidence that for the "more heterogeneous populations . . . , 'race' and psychology appear, [now] . . . to be unrelated." If this is true, the hope for true democracy lies in broadening the educational and economic opportunities for all persons in our society.

Culture is the key concept in the science of man. Yet this is a much misunderstood term. Employing the method of the Socratic dialogue to develop "The Concept of Culture," Kluckhohn and Kelly (Harvard) introduce four anthropologists, a philosopher, a psychologist, a biologist, a lawyer, and a business man. The discussants segregate culture, a way of life, from society, a group

of people; and they distinguish between explanatory and descriptive levels of culture. The dialogue makes for a long essay. The effort to define the concept and make it intelligible to the lay reader doesn't quite come off. The utility of this essay, moreover, is impaired by its having been shortened by one third from a mimeographed draft which the authors circulated among their colleagues. Nevertheless, the layman can discover how anthropologists employ the concept culture and what they mean by it. He probably would like it in shorter compass. This will require a new paper. It is an important lesson for our civilization to learn that the Japs and Germans are not what they are because of their genes.

From an understanding that cultures walk about on pairs of legs it is a short step to realizing that personality types are shaped by the history of individuals living in societies. "The discovery that personality norms differed from different societies" has shocked both ethnology and personality psychology into new approaches to mutual problems. Abram Kardiner (Columbia), an eminent representative of the latter discipline by virtue of his large study *The Individual and His Society* (1939), develops "The Concept of Basic Personality Structure as an Operational Tool in the Social Sciences." Already the union of personalist and ethnologist has produced fertile progeny who operate at levels beyond the reach of old line adherents to either discipline. It is difficult to see yet how the new techniques that have been developed in this field may be applied to current problems because the findings already fly in the face of vested interests, organized on the dominance-submission principle.

Although cultures over the world exhibit great diversity, as ethnological studies have abundantly shown, they also have certain basic similarities. In discussing "The Common Denominator of Culture," Professor George Peter Murdock (Yale; currently in Naval Government) crams into small compass some findings from his own tremendous reading that gave substance to the Cross-Cultural Survey at Yale. "The true universals of culture," he finds, . . . "are similarities in classification, not in content." Thus the common denominator becomes the structure of Wissler's "universal culture pattern." The roots of the single plan he seeks in "the fundamental biological and psychological nature of man and in the universal conditions of human existence." Since cultures have to be learned by individual members of societies, considerable space is devoted to the nature of the learning process, a topic which Dollard (his colleague) takes up in a later chapter.

No living culture is ever static. Culture change claims two chapters. Herskovits (Northwestern) discusses "The Processes of Cultural Change," following an essentially historical approach to cultural dynamics as opposed to "those who hold the nonhistorical point of view 'framing' their investigations in terms of cultural stability." This is an eminently clear and useful statement. It is important to recognize that "the cultural focus of our modern society lies in the field of technology);" "that the inventor of intangibles is rather termed a revolutionist. . . ." Hallowell (also Northwestern) treats "Sociopsychological Aspects of Acculturation," which is an attempt "to understand the conditions and processes involved in borrowing [when peoples meet] and the effects upon the mode of life of the peoples concerned." Although many of its conclusions apply to so-called simpler societies in contact with western civilization, it is equally true that we moderns who find ourselves in closer proximity to neighbors in distant lands can no more go back to "the old life" than the Cree Indians of James Bay.

So much for the anthropological background leading up to Linton's "Present World Conditions in Cultural Perspective." Here culture as science reaches out to embrace the world. Pointing to similarities between the organization of cultures and the organization of individuals, Linton illustrates certain disharmonies and bents; techniques of production known to the society and shifts of interest determine how far such developments will go. Thus social evolution may be measured by certain basic discoveries: tools, use of fire, agriculture, new sources of power, and the scientific method. Thus given the tremendous productive power of modern industry and of scientific agriculture, the student of man finds encouragement in the increasing number of individuals who recognize the need of conscious planning. Lest we feel too smug, Linton reminds us that among the other cultures besides the Western nations it may be some "backward" people who may "adapt the machine to man rather than man to the machine," producing the stable and enduring civilization that we sophisticated moderns have failed, so far, to build.

The contributions of some of the nonanthropologists to the world view are among the more satisfying chapters. Howard A. Meyerhoff (Smith) succeeds admirably in assaying for the nonspecialist "The Present State of World Resources;" and "Population Problems" by Karl Sax (Arnold Arboretum, Harvard) is brimful of interesting leads.

Although important as special problems, it is difficult to reconcile "The Changing American Indian" (Steward) and "Some Considerations of Indianist Policy" (Gamio) with chapters on global problems, when the symposium devotes no

space to the problem of the Arabs and little to the Jews, Negroes, and Japanese-Americans.

What the science of man can contribute to mitigating evils in the perennial colonial problem is more central to the present world crisis. No anthropologist is more nearly aware of this than Raymond Kennedy (Yale). His essay "The Colonial Crisis and the Future" bespeaks clear conception of the problem, vigorous powers of analysis, and a fearless advocacy of international democratic action. Between the free countries, principally in North America and Europe, and the world's dependent peoples, living mainly in Africa, Asia, and Oceania, Kennedy notes a clear pattern of segregation. His universal traits of colonialism are: "the color line; political and economic subordination of the native population; poor development of social services, especially education, for natives; and rigid social barriers between the ruling class and the subject people."

"Applied Anthropology in Colonial Administration," by Felix M. Keesing (Stanford), points out what the anthropologist has and can contribute to easing the transition of native peoples to the changes which contact with modern civilization inevitably bring. Whereas governments have in the past maintained research organizations devoted to building up background information on native peoples, Keesing would have them add a practical research arm designed to aid colonial officials with studies of "culture contact." He wisely abstains from advocating that the researchers become administrators.

In another area, since their reference has been Western Civilization, the reader will find collateral support for many points raised by the anthropologists in "The Problem of Minority Groups," Louis Wirth (Chicago); and in "Techniques of Community Study and Analysis as Applied to Modern Civilization," Carl C. Taylor (Department of Agriculture). The former lends much understanding to events in Europe as well as in this country, and the latter is an introduction to a method of social analysis that has grown *pari passu* as an integral part of scientific agriculture in America.

Of peculiar interest just now is one other paper, "Communications Research and International Cooperation," Lazarsfeld and Knupfer (Columbia and OWI). Communications research is a relatively new field, and the experience that is being had during the war offers much to future educational and informational activities. What are the limits of freedom and of authority in international discourse?

The political scientist, Grayson Kirk (Columbia) warns his colleagues, in winding up the symposium, that "in a world filled with many small states, a few of medium size, and a very few of surpassing power, the development of satisfactory international collaboration . . ." will be most difficult. Whether we can maintain the conditions of collaboration that are indicated remains to be seen. These students of man have had their say. Nonetheless, as Kirk concludes, "The millennium, however, is not at hand."

ANTHROPOLOGY AND THE PROBLEMS OF HUMAN ADJUSTMENT

By MELVILLE J. HERSKOVITS

DEPARTMENT OF ANTHROPOLOGY, NORTHWESTERN UNIVERSITY

The Governing of Men. Alexander H. Leighton. 404 pp. Illus. 1945. $3.75. Princeton University Press, Princeton, N. J.

THE circumstance of the war has done much to underscore in the minds of scientists the social significance of the problems on which they are engaged. Applied science is nothing new so far as the exact and natural disciplines are concerned, since the relationship between science and technology is one of long standing—almost as long as the history of these disciplines themselves. Among the social sciences, however, which are younger, while the immediacy of scholarly study to the everyday affairs of man's existence has long been obvious, the techniques of transfer akin to the work of the engineer in applying the findings of the research physicist or chemist to industry have been almost entirely lacking. Intervention in human affairs is so direct, and can hold such far-reaching consequences, that not only has there been reluctance to assume the heavy responsibility entailed, but many students of society have doubted whether the degree of objectivity essential to the successful intervention of social science in the direction of human society has been achieved.

In the case of anthropology, an interest restricted to studies of the history and processes of human culture and the range of variation in human social institutions began, some two decades ago, under pressures exerted by European Colonial Offices, to make a place for research pointed toward drawing up practical measures to be applied to the governing of the subject peoples of the several empires ruled from the homeland. In the New World, concern with the Indian had a

similar effect—though the ends sought were not the same—as the problem of the Indian in various countries began to press for solutions based on scientific analysis rather than purely polictical measures. Thus in the United States, aside from a tendency to apply some of the techniques of ethnology to investigations of American communities and to certain problems of industry, the Indian Bureau became the principal agent in promoting what came to be termed applied anthropology.

During the past war, when an entire way of life was under attack, anthropologists like other scientists did not pause to argue about the terms on which such services as they might render in putting their specialized knowledge at the command of those who were in need of it to wage battle, were to be employed. For anthropologists, perhaps more than those of any other scientific discipline, had cause to understand the nature of the war that was being fought—a war of ideologies which, if Fascism had triumphed, would have meant the end of their scientific activities except as these might be useful to perpetuate the rule of a self-styled master race. They did what they could, and if what they did contained a considerable measure of improvisation, this was because the questions they were called on to answer were even newer to them than were those put to men in the other sciences.

How old techniques were adapted to new situations is well illustrated in the book under review, the report which Commander Leighton, "a psychiatrist who had some previous experience in studying Navaho and Eskimo communities," renders of the work he and his anthropological colleagues of the Research Unit he headed did in advising as to the administration of Japanese evacuees. For here was one of these new and untried problems, in which the leisurely procedures employed in the researches of peacetime had to be put aside under the urgency of meeting day-by-day demands of human beings under stress and where recommendations had to be couched, not in the long periods of the scientific article, but in short, understandable memoranda to administrators who could make use only of suggestions that could be translated into action.

The setting of Commander Leighton's work was Unit I, Poston, Arizona Relocation Center where, during the month of May, 1942, about eight thousand Japanese evacuees from the West Coast found themselves interned for what, as far as they knew, would be the duration of the war. They represented all the socioeconomic strata of any American minority group, from the bachelor casual laborer in the California fruit-growing industry to well-to-do merchants and lawyers. They represented all degrees of acculturation to the American scene, from the immigrant who had never learned any English to the college graduate who was to be distinguished from his American fellow-students only by his physical characteristics. Finally, they represented the three principal categories of Japanese in America. These were the Isseis, born in Japan and intending eventually to return there, none of whom were American citizens; the Niseis, or "American-born, American-citizen, and American-raised children of the Isseis;" and the Kibeis, or the Niseis whose "formative years had been spent in Japan and who . . . returned to America bringing with them types of behavior that made adjustment difficult in this country" (pp. 67–80).

The experiences of these Japanese immediately prior to their coming to this camp had been trying. Though many of them knew nothing other than American life, and most of them were later proved to be loyal to this country, they had been treated as treacherous aliens. Their funds had been frozen so that it was impossible for most of them to carry on their accustomed trades or, indeed, to earn any livelihood; the FBI had periodically and without warning taken them into custody; some had on short notice been shifted from residences of long standing; the newspapers had inveighed against them; they suspected, not without reason, ulterior motives on the part of competitors who might want them out of the way; they had been threatened with mob violence; they had nowhere to go. That these experiences materially contributed to heighten the tensions and increase the suspicions manifest at Poston and other Centers, suspicions which in Camp I eventuated in the strike that is the climax of the author's narrative, is apparent from the quotations he cites concerning these phases of preevacuation conditions.

One gathers from this book that Poston was the only one of the ten Relocation camps that permitted research on the part of anthropologists and psychologists, and that utilized their advice. This was because this camp was located on the Papago Indian Reservation, and thus came under the control of the Indian Service as well as of the War Relocation Authority. But it was the Indian Service which, since the assumption by Mr. John Collier of the Commissionership, had turned to the social sciences for assistance in solving the problems of Indian administration. While the experience in using applied anthropology in the Indian Bureau brought advantages to the Poston setting, divided authority introduced a note that did not make adjustment any the easier in a camp

thrown together in the desert, without any of the amenities of American life for the internees who had been accustomed to them, or any chances of attaining the standard of living under which their lives had been ordered before the war.

The situation was almost as difficult for the administrators as it was for the evacuees. Faced with an entirely new problem, they had to feel their way toward solutions under the handicap of dealing with a group of people whose traditional ways were in many respects foreign to the administrators' experience. Out of this arose the reaction on their part that permitted Leighton to classify them into two broad categories, those who were "people-minded" and those who were "stereotype-minded." To the first group, the evacuees were "people first and Japanese secondarily;" to the second, they were "Japanese first and people secondarily" (pp. 81 ff.). This second group, which included minor officials, technicians, and long-term government employees, were found to have an educational background in the main inferior to those who were "people-minded." They were therefore susceptible to patterns of thought that subordinated individual differences to concepts of groups taken as wholes—a state of mind whose far-reaching consequences are amply documented in this book.

There is no space here to detail the frictions that led up to the strike, nor the manner of its settlement, nor how it resulted in a somewhat better adjustment than before, for only a full-length narrative can do justice to this sequence of events. Nor is it to be assumed that the settlement of the strike was due to the utilization of the knowledge of the research staff by those in whose hands lay the decisions that had to be made. A certain amount of such advice, particularly after the strike, seems to have been acceptable. But one need only read of the devious route which Leighton was forced to travel in order to obtain a hearing to realize that a major problem in the application of social science on any level is to induce those who make policy to listen to the recommendations of such experts as they may have available to them.

The importance of this book is not in its record of the incidents at Poston, nor as a report of what Leighton and his associates did there, but rather in the analysis they have made of the situation and the practical suggestions they present to administrators who must deal with groups whose cultures differ from their own. Of importance, too, is the fact that the broad view is never lost sight of. An instance of this is where, in the body of the descriptive text, one encounters passages such as the following: "The precedent established in handling the Japanese has direct bearing on the future security and behavior of these other (minority groups). The treatment of one minority is a rip-cord that leads into the affairs of others, particularly during war when there are unusual opportunities for exploiting the labor of minority peoples, and when the irritations and frustrations of the times easily lead to emotional sprees of aggressive expression at the expense of scapegoats" (p. 53). Of a similar import is the repeated pointing of findings from the Poston experience to the governing of occupied countries (pp. 263, 280, 285, 291, 306, 335, 342); the realization that the Poston strike resembled in its principal characteristics Japanese peasant uprisings (p. 195); or the reminder that "face" is important in American as well as in Japanese tradition (p. 174).

The principal objective of the book is given at the outset where, in the introduction, it is stated how, beneath the problems of adjustment presented by the strike, were matters of deeper import, ". . . the question of what in all this is recurrently human." And this theme is returned to in the second part of the book where, in a series of principles and recommendations to administrators based on these principles, the "recurrently human" elements in the events described are drawn on to give guidance in terms of "the real body of constants and laws in human living," the author feels that "his hands, groping blindly beneath the surface, touched here and there."

In these concluding chapters, the author moves from fundamental postulates such as the basic unity of mankind and the great variation in the customs of differing groups of men—with recommendations as to a general approach to problems involving a plurality of cultures that most of us might profitably remember if we are to adapt ourselves to the demands of a world society—to more specific considerations. These are broken down into three categories, which derive from the psychocultural approach employed, as they relate to individuals under stress, to systems of belief under stress, and to social organizations (a term unfortunately employed in place of the better designation "culture") under stress. Finally, there is an historical and methodological appendix written by the author and one of his associates, Dr. Edward Spicer, which tells of the organization of the research unit, how it worked and how its materials were organized, and indicates the results achieved by it, both in terms of publications issued and advice accepted by the administration it was set up to serve.

This book, of course, does not resolve the fundamental and debated issues concerning practical

or applied anthropology—its scope, its subject-matter, its aims, or the basic moral problems that arise when one contemplates the direction of human conduct that is its ultimate goal. It does not do this because such questions are not within the limit of its intent; nor, indeed, are they even implied in its treatment. Its author has taken a specific situation that was fruitful for analysis, presented that situation in terms of a conceptual framework well thought through, treated his data with insight and consideration for the human values no less than the administrative requirements. Herein lies its strength as a scientific document, its persuasiveness as pointing a way toward an applied anthropology that can perhaps utilize with effectiveness and with restraint the findings of research that are not so immediately germane to everyday affairs.

It has been said that applied anthropology, if it is to establish itself as a recognizable branch of the broader discipline, must succeed in applying anthropological knowledge with objectivity so as to yield insight into our own behavior, and to lead to the intelligent solution of our own problems, before going further afield in attempting to solve the problems of other societies. It would seem that in the orientation of his book no less than in the handling of his materials, Commander Leighton has made a good beginning toward establishing this as a recognized aim, and through it toward setting up an applied anthropology that begins to make sense.

ANTHROPOLOGY APPLIED TO AMERICAN PROBLEMS

By MORRIS E. OPLER

OFFICE OF WAR INFORMATION, WASHINGTON, D. C.

The Social Systems of American Ethnic Groups. W. Lloyd Warner and Leo Srole. 318 pp. Illus. Vol. III. 1945. $4.00. Yale University Press, New Haven, Conn.

THIS is the third of a series of six volumes which together will sum up the efforts of twenty-five writers, analysts, and field workers who made an intensive investigation of an old New England community which they call Yankee City. This particular book, according to the preface, is offered as a "detailed study of the social life of a number of ethnic groups, including the Irish, French Canadians, Jews, Armenians, and Poles." The authors explain that they are applying the same techniques and viewpoints which social anthropologists use in a study of societies of simpler peoples.

In an attempt "to communicate how it feels to be a member of an ethnic group" the book begins with sketches representing episodes in the lives of seven "fictive" Irishmen. These are designed to convey the interests, social status, manner of speech, and degree of assimilation of the Irish "ethnic" of various age and occupational groups. Then follow chapters on the spatial distribution of members of the several ethnic groups, their economic activities, the social status each group has attained, and the influence of the form of the family, the church, parochial or language schools, and various organizations on the life of each group. The last chapter is a theoretical discussion of the rate of ethnic and racial assimilation in America.

The story of large-scale immigration to this country and of the adventures of the immigrants and their children is an important one, and, though many books have been written on the subject, it is a tale well worth repeating from various vantage points and in relation to certain localities. Most studies of immigrants and their children deal with one group only. This study has the merit of discussing the eight such groups of Yankee City, of indicating the time and tempo of their arrival, of describing the backgrounds from which they came, and forces which set them in motion, the reception which they received, their relations to each other, and the characteristics of the adjustments they have made.

In respect to any one group nothing very startling or unexpected is revealed. The Jews, for instance, are pictured as first living in the poor and crowded section of town. The immigrant men established a small synagogue and continue to wear beards. They refuse to engage in economic activity which would force them to work on Saturday. They insist that their children attend Hebrew school. The women have little to say about religious matters or community affairs. Those of the second generation, however, engage in more diversified economic activities, are decidedly less orthodox religiously, and scatter more spatially. They meet a certain amount of intolerance and opposition in their attempts to buy property in desirable residential sections and to locate their new synagogue in more pleasant surroundings, but their economic and social rise is steady. By itself this a familiar tale. But it takes on meaning and perspective when considered against the background of the strivings and achievements of other groups as well.

There are, however, a number of questions which are automatically raised by the manner of treatment of the data which is attempted. One has to do with the very definition of an "ethnic." On page 28 we are told: "The term ethnic refers to any individual who considers himself, or is considered to be, a member of a group with a foreign culture and who participates in the activities of the group. Ethnics may be either of foreign or native birth." This will seem to many a loose way for the social scientist to determine the groups which are to be analyzed. No doubt the average man in the street believes that Jews constitute a special race. That does not entitle the physical anthropologist to list the Jews among the races of man. It is assumed that the scientist has some criterion for classification besides that of gossip or popular ignorance. In like manner, it is probably true that there are those who flatly claim that any Irishman is "a member of a group with a foreign culture." But there is no good reason why such prejudice should be accepted as a scientific guide. The failure of the authors to define the term *ethnic* as an individual who *actually is* a member of a group with a foreign culture rather than an individual who considers himself, or is considered to be, a member of a group with a foreign culture leads to a fundamental confusion. The authors are obviously aiming at an analysis of matters of culture or social behavior. They are trying to indicate for us to what degree an Irish subculture or a Polish subculture persists in the American environment. In science, particularly in social anthropology, a clear distinction is made between culture (learned behavior) and ancestry (heredity). But one of the vulgar sins of our time is that persons are constantly being classified culturally, regardless of the facts, according to the identity of their parents and grandparents. This is the misconception which reached a logical extreme in Hitlerism. It is discouraging to see the authors come dangerously close to what is essentially the same mistake.

Thus, the first "ethnic" we meet, the fictive Irishman, Dr. Daniel Corbett, has no discernibly "foreign" characteristics. He has grown up in Yankee City. He is a successful dentist, but over a few highballs confides to a friend that he is "in a jam" and "right behind the eight-ball." The jam seems to be his indecision about whether to spend the week end in a Boston hotel with a young widow of easy morals or to go home to his wife, Molly. His dissatisfaction with Molly arises from the fact that, because she is a devout Catholic, she refuses to practice birth control. The widow, apparently, has no such scruples. As a result of the size of his family and the attendant expenses, Corbett is not able to climb the social ladder fast enough or to live in the most fashionable district of town. The story has a happy, or at least a decent ending, however, for this time, after unburdening himself to his friend in good American slang and profanity, he decided against visting the widow.

Corbett is a descendant of an Irish immigrant. Except for that genealogical detail it is difficult to see anything peculiarly Irish about him. Certainly the fact that he and his wife are Catholics cannot be accounted a "foreignism." Some of the earliest settlers in this country were Catholics. And there are Protestant fundamentalists who are just as strongly opposed to birth control as is Molly. The incongruity here stems from choosing members of an ethnic (culturally defined) group on a genealogical (biological) basis. This is done not only in Dr. Corbett's case, but for all the denizens of Yankee City. They all become members of an ethnic group or not, according to ancestry. As a result the authors end up with approximately half of all the residents of Yankee City members "of a group with a foreign culture," which is, on the face of it, an absurdity.

The authors claim that in writing this volume they have utilized the same techniques and viewpoints which they apply to the study of societies of simpler peoples. That may be, but it is also certain that they have used techniques and types of evidence which many social anthropologists would hesitate to employ. I do not think the social anthropologist ordinarily accepts as valid evidence concerning a people the pronouncements about them which come from none-too-friendly neighboring tribes. Yet the authors lean heavily upon characterizations which members of one "ethnic" group use to describe members of another.

For instance, source materials such as the following excerpts are used to prove that the immigrant generation is usually over-solicitous about money and savings:

> An F_2 Irish attorney, who, like all the local Irish, does not class the Irish among the "foreigners," made this observation: "These foreigners are funny people. They will work in the factory and make good money, but they will never spend any of it. . . . They save their money and when hard times come they will go the welfare board to get aid and at the same time are liable to have money in the bank" (p. 81).
>
> A Welfare officer reported of the Italians: "The Italians have raised a great stink because they haven't received any Red Cross flour. So the cases of all the Italians were investigated, and it was found that almost all of them had $300 or more stored away and yet they were hollering for free flour" (pp. 81–82).
>
> A more tragic incident occurred in a case of which

a native nurse tells: "The Poles don't like to spend money. There is one family here that own their home. The woman has cancer and the doctors have told her for a long time that she ought to have X-ray treatments. But they wouldn't spend the money and now it is too late" (p. 82).

How much a third-generation American lawyer who starts a conversation by observing, "These foreigners are funny people," is likely to really know about the home life and economics of the Polish immigrant is a moot question. Moreover, it would be interesting to know whether welfare records bear out the charges of the welfare officer or whether one or two cases were multiplied in the interests of obvious prejudice. That the immigrant woman who spurned advice concerning X-ray treatments did so because of the money involved is one explanation. There have been so many similar cases where fear of a doctor or of medical treatment was involved that it is difficult to take the nurse's reasoning as final. All in all, much of this evidence sounds like the "anti-relief" mutterings which arose among a section of those who were still solvent during the depression of the 1930's.

In the last chapter the authors take up the question of assimilation and finally provide what they name a "Table of Ethnic and Racial Assimilation." Hitherto most writers on the subject have defined assimilation in terms of the behavior patterns of the immigrant or minority group and the degree to which its members have approximated the standard usages and acceptances of the greater society. In this book the word is read to mean the degree of resistance which the larger group offers to the presence and economic and social movement of the smaller. Amalgamation and the rate at which a group disappears, rather than cultural adaptability, seem to be the criteria. Thus the Negroes and the Orientals are said to assimilate "very slow" and to be subject to "great to very great subordination." This shift in definition, without adequate discussion or clarification, will seem to the thoughtful to be most unfortunate, especially at the present time. It plays into the hands of elements which are asserting that Negroes and Orientals are unassimilable and that we need more drastic segregation and further immigration restriction. I cannot help thinking that if one-half of the energy that went into the preparation of novel statistical and tabular arrangements for this book had been saved for thinking through the elementary concepts with which the authors deal, the results would have been of more enduring value.

It is decidedly an overstatement to call this book a study of the social systems of American ethnic groups or to say that it employs the methods of social anthropology. It is a study of the social and economic mobility of the immigrants who came to these shores and to Yankee City after 1840 and of their descendants. In this more delimited field a very careful and able job, largely statistical in approach, has been done. To those who are interested in questions of social mobility, the volume is heartily recommended.

NEW TECHNIQUES FOR ANTHROPOLOGICAL RESEARCH

By A. IRVING HALLOWELL

NORTHWESTERN UNIVERSITY, DEPARTMENT OF ANTHROPOLOGY

The Psychological Frontiers of Society. Abram Kardiner et al. 475 pp. Illus. 1945. $5.00. Columbia University Press, New York.

THIS volume is a distinguished contribution to that relatively new level of synthesis in the social and psychological sciences which is emerging from an increased awareness of the potent contributions that traditionally distinct disciplines can make to the scientific study of man through coordinated knowledge and the use of special techniques.

It was not so long ago that cultural anthropologists were hardly aware of the psychological significance of their data, since they were almost exclusively preoccupied either with describing and analyzing the varied cultures of nonliterate peoples, or with examining problems of a culture-historical nature. Any problems of a psychological order were considered to be in the domain of other groups of specialists. As Linton remarks in his Foreword to the present volume, "The old-style investigator was much more interested in lists of relationship terms and descriptions of religious rituals than in how children were brought up or what were the attitudes between spouses" (p. x). On the other hand, the raw data of cultural anthropology, which rapidly accumulated in the first decades of this century, were by no means ignored by all specialists in human psychology. Some of them, particularly psychoanalysts, made occasional use of anthropological material in terms of their own psychological conceptions, not always to the satisfaction of the anthropologist.

In recent years the mutual recognition of an important frontier region between psychology and anthropology has been focused chiefly in the exploratory studies that have been undertaken in order to discover the reciprocal relations between the genesis, typological range and functioning of human personalities and the differential cultural systems described by the anthropologist. For, as Linton points out, "Except in the most superficial terms, the workings of society and culture cannot be understood without constant reference to the needs and capacities of the individual. Conversely, particular individuals cannot be understood without constant reference to the cultural and social environments in which they have developed and within which they have to operate. The really pressing problem is one of ways and means; how the findings of the various sciences involved can be integrated and applied" (p. v).

Dr. Kardiner's book is a demonstration of "ways and means." In the Preface he says, "It describes and perfects a technique and claims some degree of precision in tracking down the reciprocal relations between culture and personality." This technique of analysis which Kardiner has been developing over a period of years received its initial application to the problem of personality and culture in *The Individual and His Society* (1939), the outcome of analysis and discussion with anthropologists interested in the same problems. At Columbia University Linton and Kardiner have collaborated in a joint seminar for a number of years. For any detailed understanding of the author's contribution to the study of personality and culture this earlier volume must be consulted, and for a comprehension of the more technical aspects of his theoretical position, *The Traumatic Neuroses of War* (1941) as well.

The present volume, then, is a sequel to *The Individual and His Society.* It embodies (a) further refinements of the author's operational concepts, specifies in greater detail the constituents of what he calls "basic personality" (Chap. II) and discusses the origin of value systems and social goals; (b) the concrete results of his method as applied to entirely new data (there is a summary and interpretation of the field work done in Alor, Netherlands East Indies, by Cora Du Bois and in *Plainville, U. S. A.,* by James West); (c) the checking of interpretations through the use of two independent sources of information, biographies and the Rorschach technique; and (d) a condensed account (Chap. XIV) of a projected volume which will apply the same technique of analysis "to the main currents in Western civilization."

Since this is not a technical review, it will be unnecessary to go into the refinements of Kardiner's technique; but in order to appreciate the kind of task he has set himself, his basic approach must at least be understood. For the operational tools he has developed and the kind of analysis he assays have been derived from certain questions which he insists a psychology fruitful for the study of personality and culture must be able to answer. This is why he frankly states in his Preface that, "This work stands or falls by the correctness of the psychiatric technique employed. The question resolves itself to this: Is our conception of the path of integrational processes in man correctly delineated, and is our notational system accurate enough and delicate enough to catch all modalities of adaptation?" (p. xix). Kardiner's conceptual approach to human behavior is dynamic and holistic rather than atomistic. He views psychology as the science of human adaptation (p. 5), "Its determinants, its modalities, and motivations, and of the mental and emotional phenomena that accompany the viscissitudes of adaptation. Psychology attempts to describe the minutiae of adaptation and to explain sequences of varying orders which are not apparent to common sense." But psychology is not a homogeneous science and of the many techniques available some are better "suited to special assignments though none can claim universal applicability." He maintains (p. 21) that a psychology suited to the needs of social science must be equipped with operational tools that provide access to the emotions and motivations of individuals and that transcend a single facet of adaptation, for example, perception. Above all, "It must be a genetic psychology in order to follow integrational systems from their inception, and to be able to identify their viscissitudes and modalities under the influence of various drives and the effects of controls imposed on the drives and impulses. It must be able to account for the adaptative role of fantasy and must be able to detect the emotional constituents of rational thinking . . . to track down the sources of the affectivity potential of the individual, the capacity for idealization, the patterns of self-esteem and aggression, the psychosomatic patterns, the superego formation, and the like. It must be able to analyze such complicated end products as values, ideals, religion, for these are the currency of the social life of man." "The only psychology that can approach these problems with any hope of success," he says, "is psychoanalysis." But although Kardiner is a practicing analyst, he rejects the use of "instinct" in the orthodox Freudian sense as an operational concept of heuristic value. In fact, he pointed out in *The*

Traumatic Neuroses of War (p. 137) that, like the classical psychologies and behaviorism, psychoanalysis in its use of "instinct" is an atomistic psychology. In that book he adopted what he called the "action syndrome" as his operational unit. In his present book he designates this large molar unit as "action system" (p. 21), and remarks the advantage it "enjoys is that it can be identified by cognitive, coordinative, and executive constituents; whereas the 'instinct' had to be identified by qualitative criteria only" (p. xvii). No matter how psychologists may view Kardiner's evaluations of other psychologies, he has made his own theoretical position and aims explicit; and his revision of psychoanalytic concepts he has tested, not only in his books dealing with personality and culture, but in the volume on the war neuroses.

In *The Individual and His Society* Kardiner introduced the concept of "basic personality structure" in order to identify certain psychological constellations shared by individuals of one culture as compared with another. This concept proved a useful one in making intersocietal comparisons, whereas "character" (differences between individuals) sufficed in an intrasocietal context. Basic personality, in short, "only indicates a certain range and certain modalities within which great differences can arise," a matrix, as it were, in which variant character traits develop. Useful as the concept of basic personality structure is, Kardiner is quite right in saying (p. xix) that the merits of his work by no means depend upon it. He adopted it, he says, "to obviate the lack of clarity in the terms group, national or social character, because a group can no more have a common character than it can have a common soul or pair of lungs. . . . What was new and important about this concept was not its name, but the technique of its derivation and the introduction of a genetic point of view into sociology. The concept of basic personalilty structure thus became a powerful operational implement, for through it we acquired a precise means of delineating the interrelationship of various social practices through their compatibility or incompatibility with certain constant identifiable human needs and drives" (p. 24). The reader will need to study Kardiner's exposition carefully in order to see exactly how he arrives at the basic personality structure of a given culture. It must suffice here to point out that basic personality constellations comprise a hierarchy of integrational systems that cannot be fully explained by any mechanistic theory of learning, but which originate in the actual experiences of individuals as a result of a socialization process that starts in earliest infancy. It is the author's cardinal contribution to have approached this problem in precise etiological terms from the genetic standpoint. He has also shown how these integrational systems are reinforced by later experience and has attempted to demonstrate predictable connections between different types of basic personality and the differences in attitude-value systems in various cultures. In other words, basic personality structure becomes the unconscious basis of certain projective systems (like religion or folklore). Such systems may be contrasted with reality systems; that is, devices for adapting oneself to the world through rational or realistic means. The culture of different societies is polarized in one direction or another.

Whereas in his previous book Kardiner was compelled to make all his psychological inferences on the basis of descriptive ethnographic data collected without psychological problems in mind, and therefore had no way of checking the conclusions reached, the opposite is true of the present volume. The nature of this substantiating data can best be appreciated by reading *The People of Alor* by Cora Du Bois, where a fuller account of the manner of life of these people is given, a number of biographies analyzed in detail by Kardiner, and a summary report made of the interpretation of the Rorschach data by Dr. Emil Oberholzer. The Rorschach interpretation was done independently, and its substantiation of Kardiner's interpretation of the basic personality structure of the Alorese is truly impressive.

One final problem, incidentally discussed in connection with the analysis of the Tanala in the earlier volume and the Comanche in the present one, is the relation of basic personality structure to cultural change. It is this question that Kardiner has initially surveyed in his final chapter and promises to analyze in a forthcoming volume.

The scientific importance of the work of Kardiner and his collaborators lies in the effort they have made to devise ways and means of identifying the actual etiological factors that are responsible for moulding the human personality under varying conditions, the constant checking of hypotheses and the avoidance of a dogmatic attitude with respect to final conclusions. When the method is tested further and the results of additional studies are before us, we may find that one of the cornerstones of a scientific social psychology has been laid.

IMPRESSIONS OF INDIA

By RALPH W. PHILLIPS

SENIOR ANIMAL HUSBANDMAN, U. S. BUREAU OF ANIMAL INDUSTRY, BELTSVILLE, MD.

WHEN India is mentioned, Americans may think of vastly different things: One may think of rich palaces, stately tombs, the oriental pomp and splendor for which India has long been legend. Another may think of the poverty of the masses, and the lack of knowledge and appreciation of facilities and practices that are essential to sanitation and health. Still another may think of religious fanaticism, of creedal differences between Mohammedan and Hindu, and of confused politics so intimately interwoven with religion that it seems impossible to separate the two. Others may think of a caste system based on far different concepts and sociological foundations than our own ideals of life, liberty, and the pursuit of happiness, or of sacred cows that man dare not violate, even to end their misery when they are mortally injured or ill.

India is all these things and many more. This varied country might well be described as a land of contrasts.

The towering Himalayas bound India on the north, and this range bends southward into Burma on the east, where it is popularly known as "The Hump" by American airmen. In the northwest lie the dry hills of Baluchistan. Below these mountains lies a vast plain. Through this plain flow the three mighty rivers of India, the Indus in the west, the Ganges in the east-central portion, and the Brahmaputra in the east. The two latter have formed a vast delta, and below where they join they flow to the Bay of Bengal through an intricate and shifting network of waterways. All three rivers are fed from the snowfields of Tibet. The eastern portion of the plain through which these rivers flow is low and wet but it becomes

Das Studio

MOUNT KANCHANJUNGA, SEEN FROM DARJEELING

KANCHANJUNGA, THE HIGHEST PEAK IN THE PICTURE, TOWERS 28,156 FEET. IT IS SECOND ONLY TO EVEREST.

LOW, WET COUNTRY IN BENGAL

THESE BOATS ARE ON ONE OF THE MANY CHANNELS THROUGH WHICH THE COMBINED GANGES AND BRAHMAPUTRA RIVERS FLOW TO THE BAY OF BENGAL.

drier towards the west. In those parts of the western plains where the rivers do not flow (Rajputana and Baluchistan) the land is a desert. All the regions just described may be called roughly northern India. The region just south of this plain is composed of a series of low mountain ranges. Southern India has a mountain range which extends along most of the eastern side of the peninsula. The narrow space between these mountains and the western coast contains steppes which descend abruptly to the sea. To the east of the mountains there is a broken plateau and beyond that lie the plains of Madras.

The climate of India is quite variable. Southern India is hot throughout the year. Madras, for example, has a mean temperature of about 81 degrees F., ranging from a mean of 75 in January to 87 in May. In the Indus valley in northwestern India, temperatures range from 30 degrees F. in January to 125 degrees in May. The southwest monsoon is perhaps the most significant factor in India's climate. This midsummer wind brings a punctual but sometimes inadequate rainfall to most of the country, and economic life depends to a large extent on this rainfall. The annual rainfall varies from less than 5 inches in the Sind desert to more than 500 inches in the Khasi Hills of Assam.

In this land of geographical contrasts there are 1,581,410 square miles of earth. These do not constitute a political unit. The provinces of British India occupy 865,446 square miles while 715,964 square miles are included in the Indian States and Agencies. There were 388,997,955 people tabulated in the census of 1941. Of these, 295,808,722 were in British India, while the remaining 93,189,233 were in Indian States and Agencies. They differ widely in their racial origins, religious beliefs, customs and modes of living. Approximately 87 percent of these people live in rural areas.

India is too large and too varied a country

BULLOCKS AT WORK IN NORTHERN INDIA

Left, PULLING A PLOW ON THE PLAINS; *Right,* FROM A SHALLOW WELL THE ANIMALS LIFT IRRIGATION WATER.

A TYPICAL VILLAGE SCENE

THE VILLAGE POND OR TANK CONSTITUTES ONE OF THE MAJOR SANITATION AND HEALTH PROBLEMS IN INDIA.

to know intimately after only a few months. But like all other distant parts of the globe, India is being brought nearer to America by steady improvements in communications and transportation, and it is increasingly important that we Americans know more of these once-distant lands that are now becoming our near neighbors in world affairs. So the viewpoint of one who studied the livestock and the animal husbandry institutions of India and pondered over the problems that must be surmounted in order that the livestock of India might serve that country more effectively may add something to our understanding of India and her people.

My visit in India occurred during 1943 and 1944, while en route to and from China on a special mission for the Division of Cultural Cooperation of the Department of State. I have already referred to the oriental pomp that is part of India's heritage. It was with considerable pomp that I entered India on the backs of four turbaned stretcher bearers. Illness had overtaken me while en

CATTLE AND WATER BUFFALOES

AS THESE ANIMALS MOVE TO PASTURE, THEY ARE USUALLY HERDED BY THE YOUNG OR OLD OF THE VILLAGE.

POMP AND CIRCUMSTANCE

LARGE BRASS IDENTIFICATION BADGES ARE WORN BY GOVERNMENT ATTENDANTS OR MESSENGERS CALLED PEONS AND BY SIMILAR SERVANTS OF BANKS, ETC.

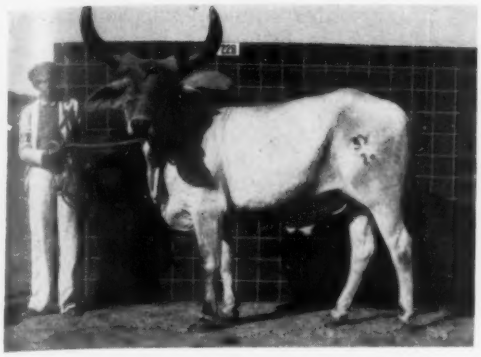
route from San Francisco to Bombay, so my first impressions of India were from ambulance and hospital windows; glimpses of brilliant-colored flowers, of costumes so varied they shock one accustomed to the relative uniformity of American fashions, and of motor, animal, and man-powered traffic moving along the "left" side of the streets. Recovering sufficiently to leave the hospital in Bombay, I traveled to Calcutta on one of the very few air-conditioned trains in India, and from there went to Darjeeling to enjoy the mountain air and regain strength before crossing "The Hump" to China. My real opportunity to see India came after completing a mission in China. At the invitation of the Government of India I was privileged to travel through much of the country, under the auspices of the Imperial Council of Agricultural Research, inspecting animal husbandry institutions, and visiting livestock-producing areas.

India is primarily an agricultural country, and a large portion of the population lives close to the soil, either on farms or in villages from which they go forth to till the surrounding fields. Farms are generally small and tools are primitive except in relatively small areas where improved equipment has been introduced. Under these farming conditions animals are essential for power. There is relatively little feed for types of livestock other than those used for power since most of the grain and other food produced is required for human consumption. Approximately 75 percent of the cultivated area is in cereals, the two principal crops being rice and wheat. Sugar, cotton, jute, and tea are also important crops. In the drier regions and in some areas where crop farming has not been developed, pastoral pursuits are more common, and cattle, sheep, and goats are used to harvest grass and other forage, turning them into products that are edible or otherwise usable by man. Horses and donkeys are also used to some extent in the drier areas, and camels are important in northwestern India. Because gasoline is expensive, many bullocks and other animals are used for draft and packing in cities and on the highways, roads, and trails.

The recent famine in Bengal was one of the major catastrophes of the war, and a study of the factors contributing to it shed much light on the nature of Indian life and economy. The following statement made by one witness before the Famine Inquiry Commission gives the background concisely:

> Until Japan declared war, India had no serious food problem beyond the fundamental truth that two-thirds of its population normally existed at a level little above the starvation line, and by western standards, well below it. That in itself is an important fact, the effect of which is to be fully grasped before the true significance of the situation which ultimately developed can be understood. The effect was that a slight disturbance of the economic practices of the country, and a small diminution of the overall available supply, had consequences altogether out of proportion to their intrinsic gravity. So delicate was the balance between actual starvation and bare subsistence, that the slightest tilting of the scale in value and supply of food was enough to put it out of the reach of many and to bring large classes within the range of famine.

Such a shifting of the balance in value and supply of food took place. The winter rice crop in 1942 was deficient, and the stock carried over from 1942 to 1943 was below normal. The provincial government failed to control the price and distribution, and many found this basic food beyond their means.



A KANKREJ BULLOCK AND A SAHIWAL COW

Left, THIS TYPE IS USED PRIMARILY FOR DRAFT; *Right*, THIS IS ONE OF THE FEW MILKING BREEDS IN INDIA.

Loss of normal imports further aggravated the situation, for imports from Burma were cut off and restrictions were placed on the movement of grain from one province to another. The tragic results are summed up in the following quotation from the report of the Famine Inquiry Commission:

> What happened was that producers sold their rice as they thought fit at the best price they could obtain, or held it in the hope of still higher prices. Traders bought, held and sold with the object of obtaining maximum profits, and consumers who could afford it bought as much as they could and not as much as they needed. The results were on the one hand unprecedented profiteering and the enrichment of those on the right side of the fence; on the other, the rise of prices to fantastic heights and the death of perhaps one and a half million people. It has been reckoned that the amount of unusual profits made on the buying and selling of rice during 1943 was 150 crores [112 million pounds sterling].

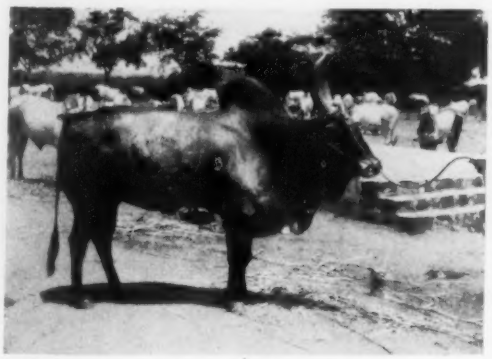
In the meantime, the country was suffering from a shortage of transportation. Further complications arose owing to lack of coordination among government agencies and the public. The starvation and the epidemics which followed bring into bold relief the narrow margin between bare subsistence and actual starvation that exists in much of India.

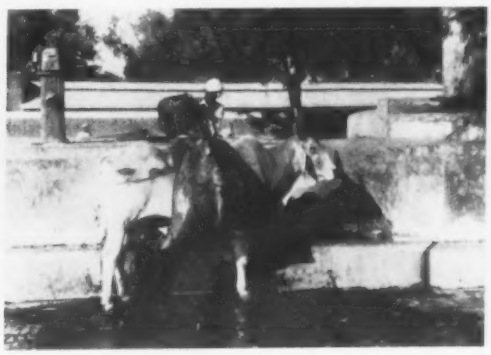
In Table 1 is a comparison (Morris, 1945)

TABLE 1

THE NRC OPTIMUM DIET VS. THAT OF THE INDIAN RICE EATER

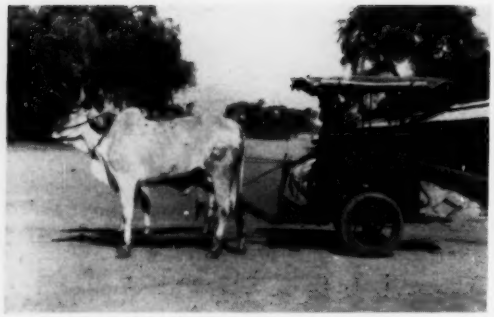
Diet	Calories	Protein (grams)		Calcium (grams)	Iron (mg.)	Vitamin (I.U.)		
		Total	Animal			A	B_1	C
Optimum	3000	70	33	0.8	12	5000	594	1500
Indian	1750	38	1	0.16	9	500	160	300





A KANGAYAM BULL AND A HISSAR BULLOCK

Left, A DRAFT BREED OF SOUTHERN INDIA DEVELOPED BY THE PATTAGAR OF PALAYAKOTTAI; *Right*, WATER BAGS.



A BULLOCK TONGA
THESE LONG-LEGGED BULLOCKS ARE ABLE TO TROT.

of important constituents of the diet of the typical poor Indian rice-eater with the optimum diet recommended by the National Research Council. It further emphasizes the low level of nutrition upon which many Indians exist.

In the face of this low dietary standard, Indian population increased by more than fifty millions from 1931 to 1941. Thus, at this rate of increase, there is the problem of feeding and otherwise supporting over 5,000,000 additional persons each year.

The Cattle Problem in India

Cattle are by far the most important livestock in India. The agricultural structure of the country is based largely on the use of cattle for draft purposes. Bullocks also furnish much of the power of transportation. Many of the native types are used entirely or primarily for draft, but they provide some milk for human use. European dairy breeds have been imported, particularly bulls, for crossing with native cows to increase the milk supply. Beef is consumed by some portions of the native population and by the foreign groups. Hides and bones, salvaged from dead animals and from slaughterhouses, are important by-products. Manure is used for fuel. In addition to all these functions, cattle are intimately associated with Hindu mythology and religion.

Since the cattle occupy such important places in Indian agriculture and in the religion of the major portion of the people, an understanding of the place of cattle in national life sheds much light on the problems of agricultural, economic, and social improvement.

In the census of 1940, the number of cattle of all ages tabulated was 162,729,555. This number includes figures for a few areas obtained in years other than 1940. The actual total is probably somewhat larger since some of the Indian States did not participate in the census.

For many centuries the majority of the people of India have been vegetarians. Therefore, they are in greater need of milk and its by-products than people of most other countries.

Milk and milk products provide the chief source of animal protein in the Hindu diet, but little concrete information is available on the milk production of Indian cows, outside a relatively few animals in government-owned or sponsored herds. However, a survey has been made which gives some information on the village cattle (Imperial Council of Agricultural Research, 1939). It was made in seven typical breeding tracts and was conducted during the winter months. The average daily milk yield observed for cows was 3.74 pounds, and the estimated yield per lactation was 943 pounds. Water buffaloes were also included in that survey, and the figures for daily and lactation yields were 7.82 and 2,160 pounds, respectively. The average milk production per capita in the areas studied was 23.36 ounces, while the consumption of milk per person was 10.16 ounces. This included the ghee, curd, and other milk products expressed as milk

AN INDIAN DAIRY SHOP

equivalents. The remaining 13 ounces were sold.

The average daily consumption (ounces) of fluid milk by persons of various ages and the two sexes is of interest since it apparently reflects the predominant position of the male, particularly in the Hindu family:

Age Group	Male	Female
Adults	6.63	3.34
Children	5.82	3.77
Infants	3.77	2.53

It was also observed that the proportion of females receiving milk was uniformly less than that of males.

It should be emphasized that the data on milk production and consumption summarized above were obtained in tracts where cattle breeding is an important pursuit. In other areas, where breeding is of less importance and many working bullocks are purchased, the available milk supply would undoubtedly be lower. One authority has estimated that the supply of fluid milk for the whole population is less than one and one-half ounces per day.

Definite data on milk consumption in the cities are not available. Some milk is carried into cities from country districts but most of the milk in the larger cities is produced within the city limits. For example, it is estimated that approximately 50,000 cattle and buffalo cows are imported each year and are quartered in the city of Bombay for milking.

India is a land of castes. Each caste is a sort of trade union and its members have been doing the same type of work in much the same way for many generations. Members of a number of pastoral castes, such as the *Ghosi* and *Gwale*, have long combined the breeding of cattle with the raising of crops. These pastoral castes once had plenty of free pasture land upon which to graze their cattle. Bakhsh (1944) points out that the security of life and property afforded under the British government has given impetus to tilling of land, so that every available piece of ground is utilized for the growing of crops. Under these conditions, many of the members of these pastoral castes have migrated into large towns and cities.

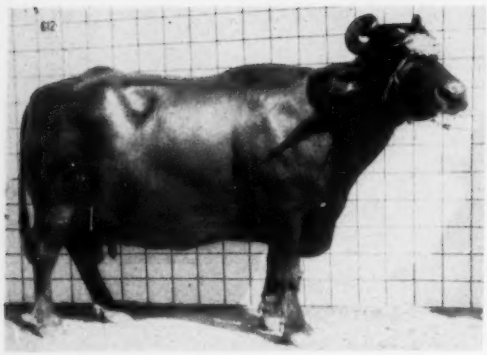
MANURE FOR FUEL

CATTLE DUNG IS COLLECTED, CAKED, DRIED, STORED.

These transplanted pastoral people constitute some of the most backward communities in India. They are too poor to afford good housing for themselves or their animals, so usually live in the poorest sections of the towns and cities. They often lack sufficient capital to purchase cattle, so must borrow

THE INDIAN BARBERSHOP

BRICK FRAMES LIKE THAT IN BACK OF THE BARBER ARE BUILT AROUND YOUNG TREES TO PROTECT THEM FROM THE CATTLE THAT ROAM THE STREETS.



A MURRAH WATER BUFFALO COW
"MURRAH" MEANS CURLED, SO THIS BREED IS NAMED AFTER THE CURLED HORNS. IT IS THE MOST IMPORTANT OF THE BREEDS OF WATER BUFFALOES.

from the *bania*, or money lender, at an exorbitant rate of interest. Under these conditions the owners of the cattle are constantly in debt and have no opportunity to better their own conditions or those of their cattle.

Under the conditions generally existing, milk delivery methods are quite primitive, and standards of sanitation commonly practiced in the United States are unknown. A limited amount of milk is delivered in capped bottles in the larger cities, but much of it is delivered by other means. In some areas, according to Wright (1937), it is usual for milk to be sold in bazaar shops; in others some of the milk is delivered to the purchaser's home and some is sold in retail shops, while in others the cow is driven from door to door and milked in the presence of the customers. Milking is done almost universally with wet hands. Transport to market is by head load, bicycle, or cart. The vessels used frequently have no lids and the mouth of the vessel is therefore generally stuffed with grass or straw. Adulteration of milk is common. Figures published by Wright show that approximately one-third of all samples tested in nine provinces were adulterated and that the water added varied from small amounts up to approximately 50 percent. Contamination of milk, the hot

BHUTIA PONIES WAITING FOR BUSINESS
HILL TRIBESMEN TRY TO SELL RIDES TO VACATIONISTS IN DARJEELING AND OTHER MOUNTAIN RESORTS.

INDIAN TAXIS

Left, A SCENE IN BOMBAY SHOWING A VEHICLE CALLED A GHARRY; *Right*, A CAB IN NEW DELHI CALLED A TONGA.

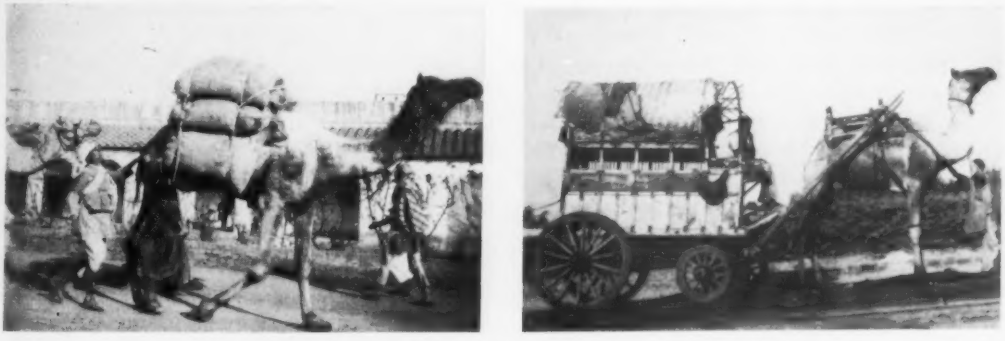
climate, and lack of refrigeration make it difficult to keep milk for very long. Fortunately, the practice of boiling milk before use is almost universal in India.

Much milk that is not used as whole milk or for production of ghee is made up into various types of milk sweets and products of soured milk. The sweets are made by condensing the milk to a suitable consistency and adding sugar and other materials. Many of them are very tasty. Some milk is soured to make special products. Much sour milk is available from the churning of soured whole milk for butter. Butter is then clarified by heating to produce ghee.

There is much room for improvement in milk-producing methods to provide better sanitation, but it should be recognized that the expense of many of the techniques used in the United States would so increase the price of milk as to put it out of range of much of the population.

Owing to the emphasis on draft power in India it is only natural that most of the types and breeds of cattle developed are specialized for work in the fields or on the highways. These animals give very little milk; however, certain breeds have been developed in which milk production has been emphasized. For the most part, these have been developed by tribes living in rural areas where grazing of livestock was a major occupation. At least six major types of cattle are generally recognized in India and within some of these types there are several breeds. These are described elsewhere (Phillips, 1944) along with summaries of available data on their milk production under improved conditions on government-owned and supervised farms.

Many rural sections have more cattle than the available range and pasture can support. In these areas death losses from starvation or from disease coupled with lowered resistance are frequent. Religious prejudice among the Hindus makes it very difficult to



A DROMEDARY AND A CAMEL CART IN NEW DELHI

A RIDING CAMEL IN THE PUNJAB

reduce the numbers of cattle to the point where available forage will support them adequately.

One of the serious problems in Indian agriculture is the maintenance of soil fertility. Most of the manure from cattle is not returned to the land but is used for fuel. It is carefully collected from city streets, highways, and fields and made up into flat cakes either on the ground or stuck to the walls of the buildings. After it is thoroughly dried, it is stored and burned as needed.

Most of the efforts to improve Indian cattle in which any scientific methods have been followed have been conducted at government-owned farms or privately-owned farms subsidized and supervised by government workers. At the present time there is only one outstanding example in India of cattle improvement work being done by a private party without government support. This is a rather unexpected situation in a country where cattle are held in higher esteem than in any other country in the world.

The military dairies are among the important organizations contributing to the regular supply of milk and to cattle improvement. Army officials, in order to be assured of a constant and clean milk supply, have found it necessary to establish their own dairies. These are managed in up-to-date fashion and have modern equipment for processing milk.

Many attempts have been made to introduce foreign breeds of dairy cattle in order to increase the milk supply. At first it was felt that these breeds could be introduced in pure form, but it was soon discovered that European breeds did not have sufficient adaptability to the hot climate of India. Some workers in India now oppose the use of imported breeds and prefer to base improvement on selection among the native dairy breeds. Others feel that the most rapid increase in milk supply can be obtained by crossing imported bulls, such as the Holstein, with the native cows, and possibly establishing new types from these crossbreds. It seems certain from available information that little, if any, more than fifty percent of European blood can be introduced and still have sufficient resistance to the environment. This is borne out by the following figures on production in cattle having various amounts of European blood, most of it from the Holstein:

Fraction of Imported Blood	Number of Records	Pounds of Milk
1/8	21	4,839
1/4	175	5,982
1/2	589	6,977
5/8	204	6,985
3/4	396	6,664
7/8	86	6,180

Animals having a high proportion of European blood grow satisfactorily up to the time of their first lactation. Then many of them show that they cannot stand the strain of the environment by becoming emaciated. During hot weather many of them have difficulty in maintaining a normal body temperature.

Many of the old, crippled, and diseased cattle of India place a continued drain upon the economy of the country because they are kept by owners beyond a useful age or are placed in the old cattle homes called *gowshalas* and *pinjrapoles*. These homes are maintained as charities or by levies on commercial transactions. Approximately 1,500 of these homes are said to exist in India. In only a

few of them is there any real effort to salvage useful animals and make them contribute something to human welfare.

The occidental finds it difficult to understand the ill treatment of cattle, which is quite common in India, in view of the reverence with which cattle are considered. It is considered immoral by the Hindu to kill an animal to put it out of its misery, but many animals die in agony as a result of disease, injury, or starvation. The Moslem policeman who would dare to put a cow out of her misery after she had been disemboweled by a street car would find himself in serious difficulty with the Hindu portion of the population. Other evidence of disregard for the comfort of animals is often found among oriental peoples. Mankar (1943) states that animals are mercilessly beaten when unable to yield milk owing to heat or estrus. He also states that about 20,000 young calves are starved to death in Bombay stables annually. These are calves brought with their dams into the city or which are born on trains en route or after cows arrive in the city. Mankar states that most of these calves die within a week or two after entry into Bombay owing to starvation and neglect, as there are no sheds for calves in the stables and it is not economical to maintain them in the city. But little is to be gained by reciting examples. The difference in oriental and occidental views of what constitutes humane treatment of animals is but a reflection of different religious, social, and economic backgrounds.

SMALL GOATS OF BENGAL

The Water Buffalo

Water buffaloes occupy an important place in Indian agriculture, but their position differs from that of cattle. Most Indian cattle are used primarily for draft power, and milk production is secondary. With water buffaloes the situation is reversed, milk production being the more important. Many

A JUMNA PARI BUCK
THESE LARGE GOATS HAVE LONG, FOLDED EARS. IN NORTHERN INDIA THEY YIELD MILK, MEAT, AND HIDES.

buffaloes are used for work, but they are considered too slow when compared with longer-legged, fast-moving bullocks of the draft breeds of cattle. Also, they are less able to withstand heat, and during hot weather require access to a pond or must have water poured over them at intervals to prevent too great a rise in body temperature.

The number of water buffaloes tabulated in the census of 1940 was 45,441,689. This did not include figures for some Indian States which did not participate in the census. These, along with the cattle, make the bovine population of India somewhat over two hundred millions.

Some comparative figures have already been given on milk production of cattle and water buffaloes in the villages, which indicate the superior producing capacity of the water buffalo. Under conditions on government-owned or supervised farms, water buffalo cows produce about 4,000 pounds of milk in a lactation of nine months, on the average. The fat content is higher than that of cattle, averaging about 7.5 percent. The fat is usually much whiter than that of milk from cattle, apparently owing to a low carotene content. The milk production of the buffalo cow is equaled or approached by only a few of the native breeds of cattle.

The water buffalo is one of India's useful animals. However, opposition to it is voiced by some Hindu leaders, who would prefer to have it replaced by cattle.

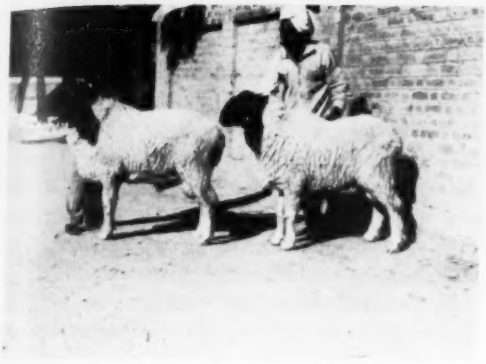
Other Livestock

Horses are of small importance in India. Compared with over two hundred million bovines, only 2,243,430 horses were tabulated in the 1940 census. The draft horse, which is so common on the farms of Europe and the United States, is not used to any extent in India. Ponies are produced chiefly in the Himalayan foothill regions, and the best saddle horses are bred in the drier regions of northwestern India. Most of the latter have some Arab blood.

Donkeys are also of relatively little importance. The number in 1940 was 2,028,467, or somewhat less than the number of horses. Donkeys are of two main types, small and large. The small ones average about 32 inches in height, while the large ones are about 44 inches high at the withers. They are used chiefly as pack animals. Mules are of very minor importance, only 79,512 having been tabulated in 1940. The donkey and the mule are held in very low regard among many Indians, some of whom would consider themselves degraded if seen riding behind one of these useful creatures.

Camels are used only in the drier portions of northwestern India. The number tabulated in 1940 was 1,109,565. They are of the single-humped type, or dromedary, and are used primarily as pack animals and for riding. Someone has described the camel as "an animal with fourteen universal joints," and a jolting ride was sufficient to convince me that the description is apt. Camels are also used to a limited extent for draft, being hitched to wagons with shafts that lead at a sharp angle up to the hump.

The combined numbers of horses, donkeys, mules, and camels total only 5,460,974. The relative paucity of these animals serves to emphasize the importance of bovines in Indian agriculture and national economy.



TWO KINDS OF INDIAN SHEEP

Left, LOHI RAMS OF A BREED THAT IS FOUND IN NORTHWESTERN INDIA; *Right*, HAIRY SHEEP OF SOUTHERN INDIA.

Goats are found in all parts of India. They are used for meat and skins, and some types produce milk for human consumption. Long-haired types in some northwestern areas are also sheared to obtain the fiber. There is much variation in size and type. Much could be done to improve both their productivity and methods of managing them so they would make a greater contribution to the national welfare. The number tabulated in 1940 was 59,369,261.

Sheep are also of considerable importance in the drier portions of India where much grazing land is adapted to sheep production. There were 49,060,959 sheep recorded in the 1940 census. These include several types. Fat-tailed sheep with very coarse wool are found in the northwestern regions adjacent to Afghanistan. Thin-tailed sheep that produce wool of somewhat better quality are found in other portions of northern and northwestern India, and in some sections of the Deccan. Another type is found in southern India which is covered only with brown hair. This type is used only for meat, skins, and manure. Wool from the other types is used in carpet manufacture and for various types of coarse cloth. Some types of Indian sheep produce enough milk to justify milking for human consumption. Ewes of one type are reported to yield as high as eight pounds daily at the peak of lactation. It is rich in fat, and some of it is mixed with the milk of cattle and buffalo and used in the production of ghee.

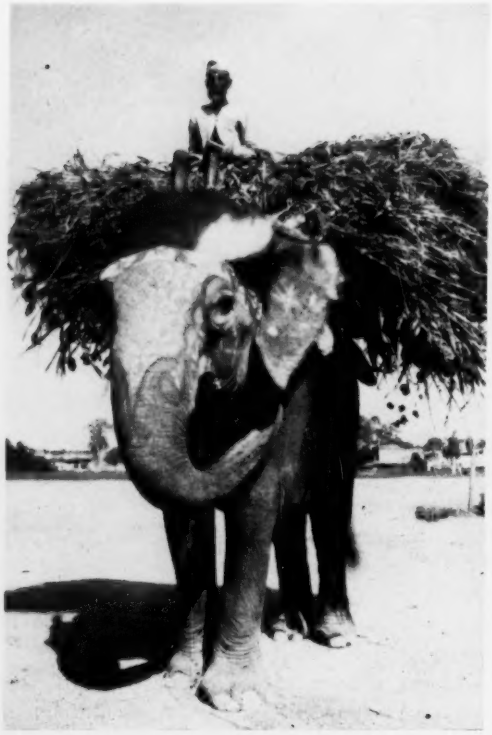
Swine are of little importance. Most Hindus are vegetarians, and Moslems will not touch pork, which therefore is used only by the foreign people and by low-caste groups. The number recorded in 1940 was 1,955,396. The presence of large numbers of foreign troops during the war increased the demand for pork and also the interest in improving breeding and production methods.

In the villages where hogs are raised, they are used primarily as scavengers and live to a considerable extent on human feces.

Chickens are of some importance in Indian agriculture. The number recorded in 1940 was 80,272,333. This seems like a large number, but when it is recalled that there are more than twice that many cattle in India, it is obvious that there are few chickens on the average farm. The orthodox Hindu abstains from eating poultry as well

HOG HOUSE IN A VILLAGE

THIS TUNNEL-LIKE AFFAIR IS THE ENTRANCE TO A SMALL UNDERGROUND ROOM WHERE HOGS CAN ESCAPE THE INTENSE SUMMER HEAT OF THE PLAINS.



AN ELEPHANT CARRIES FODDER
ONLY A FEW ELEPHANTS ARE USED IN AGRICULTURE.

as any other flesh. This also applies to eggs, particularly fertile ones, since the eating of a fertile egg would be equivalent to destroying a life. One authority has estimated the average egg consumption per person in India to be eight eggs per year.

Looking Ahead

Discussion and planning for that bright new world of the future rests on the hope that there will be enough food, clothing, medical care, and other essentials for all. Those are worthy objectives and are ideals which most Americans heartily support. However, many Americans measure the accomplishment of those objectives in terms of their own abundant food supply and the many other things which contribute to their health and comfort.

Planners for the future well-being of the world must be realistic if there is to be any hope of success. India and adjacent oriental countries are so densely populated in relation to the amount of tillable land, and their agricultural methods are so primitive in many respects, that there is no hope of increasing their per capita production of food to our levels, within any time we reasonably can foresee. At some future time sufficient reduction in populations or increase in productivity of the land or both may have occurred to make possible an approach to American standards of living. For the present, progress must be measured in terms of the existing conditions in the countries concerned rather than in terms of our own standards.

Americans who have not had experience in the Orient have so little conception of the gap between the ways of life here and there that it is difficult for them to comprehend the prevailing low standards of existence in India and adjacent oriental countries. We have felt pinched under wartime rationing and shortages in many of our favored articles of diet, but even with those restrictions we have been extremely well fed compared with the normal diet of large sections of the world's population.

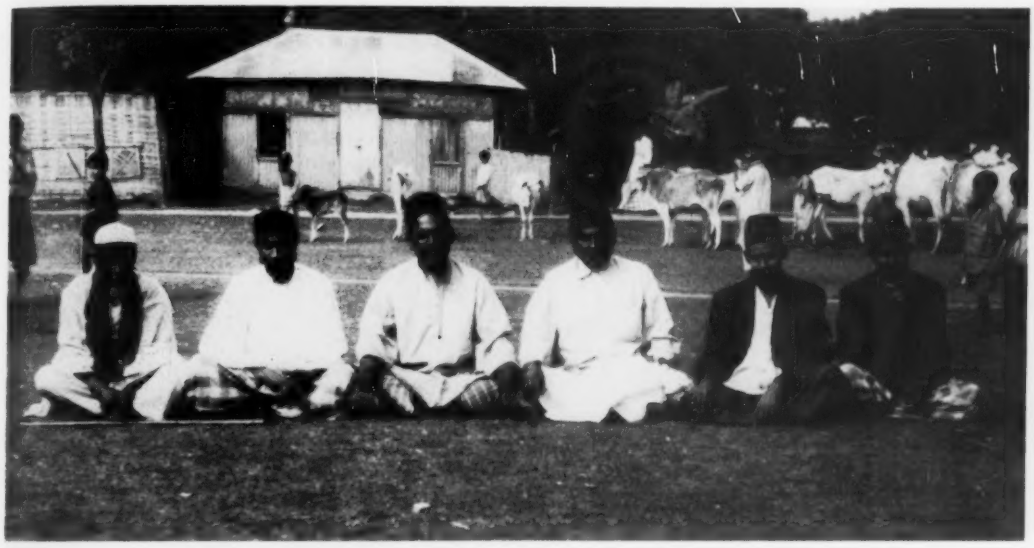
If we are to help our neighbors to help themselves, we must first understand the conditions under which they live and work, and their traditions and customs. Many of our fellow citizens of the world have less food and less of many material things than we have. But they have just as much pride in their countries, their traditions, and them-

VIEW IN THE BOMBAY STOCKYARDS
THE LARGE RICK OF STRAW IN THE BACKGROUND IS FOR FEED, NOT BEDDING. ANIMALS ARE HELD IN GROUPS BY PATIENT COOLIES. HINDUS ABHOR THE SLAUGHTERING OF ANIMALS, ESPECIALLY CATTLE.

selves. The last thing they want from us or anyone else is charity. Therefore, I use the phrase: "help our neighbors to help themselves."

The United States can produce some food above the needs of its people. But that surplus would not go far in raising the dietary intake of substandard peoples to an optimum level. If real progress is to be made in that direction, it must be largely by measures taken within the countries where the additional food is needed. We have made much progress in developing improved food production and processing techniques. Those techniques, or modifications of them to fit Indian conditions, could be applied to advantage in India, and also in some other countries. The immediate advantages are to our neighbors, of course, but in the long run there are advantages for us, including improved outlets for some of our own products and less economic disturbances to put strains on international relations.

There are several stumbling blocks in the path of introducing improved agricultural techniques in India. The level of education in rural India is extremely low, and improvement in this respect will be slow. Many religious dogmas and customs stand in the path of progress. The caste system tends to keep people in the trades and customs of their ancestors and discourages progressive attitudes among the people. Differences among Hindus, Moslems, and other religious groups often prevent cooperative studies and approaches to solutions of problems. Religion is so firmly intrenched that its influence pervades all parts of Indian life, often hampering or even openly opposing progress. India is not a political unit. Aside from the several provinces of British India, there are several hundred native states and agencies. Agriculture is considered a "provincial subject" and major responsibility for development is therefore in the hands of the provinces. Recent developments have greatly strengthened the position of agricultural work in the central government. But much remains to be done before the agricultural work of the country can be effectively coordinated. Many problems are national or at least regional in scope, and the only effective approach to them is by the use of all available personnel and equipment in a concerted attack. This is especially true in a country where the number of technically trained personnel is quite limited. Another problem is presented by the lack of practical



VILLAGE LEADERS AT A CATTLE SHOW

THESE LEADERS PROUDLY POSED DURING A CATTLE SHOW STAGED FOR THE AUTHOR IN THEIR BENGAL VILLAGE.

experience by many technically trained men. Too often, the man with an excellent scientific background is unable to bridge the gap between the laboratory and the land, since he has never worked with animals or on the land. And he is prevented from gaining such experience because working with his hands would be beneath the dignity of an educated man.

Such an array of stumbling blocks, plus others not listed, may make the path of progress seem rather hopeless. The difficulties are great, and any attempt to minimize them would only place another stumbling block in the path. Those difficulties are so great that they can be overcome only by bold, decisive action, based on the best technical information available, and upon the use of the best scientific leadership that is to be had. So the immensity of the problems of more food and better balanced diets for India, and for other countries where substandard diets prevail, is a challenge to the countries themselves and to the countries who must assume leadership in the building of tomorrow's world.

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BIRD'S-EYE VIEW

A babe released from sleep in utero
Where, all its wants supplied, it grew so fair,
Nor struggled 'til it felt the need of air,
Awakes and strives the world of sense to know.

Matured with sensory satiety
Or hammered hard with labor's ceaseless blows
Most men returning drift to seek repose
In stance secure, renouncing some variety.

A restless few maintain the childish heart
Of high adventure to the bounds of thought
And there take wings to ride exploring clouds.
Alone they see the past in its full part
And point the future as true prophets ought
In bliss beyond the need of cheering crowds.

—JOHN G. SINCLAIR

SCIENCE ON THE MARCH

INSECTICIDAL AEROSOLS*

MR. CHAIRMAN: I greatly appreciate the honor the City of Philadelphia has bestowed upon me personally, and indirectly upon the Bureau of Entomology and Plant Quarantine. This Bureau has made possible the program of research that led to the development of insecticidal aerosols. Thank you very much.

It may be of interest to outline briefly the events leading to the application of insecticides in the form of aerosols and the research leading to the development of the so-called aerosol bomb which was so popular with our armed forces.

Photo by Philip B. Wallace

THE JOHN SCOTT MEDAL OF THE CITY OF PHILADELPHIA

Before the war Capt. Sullivan and I started a study to find better methods of applying the fly-spray type of insecticide. Sprays were often low in effectiveness because of poor quality and because inefficient sprayers were used to apply them.

We decided to try aerosols. Aerosol is simply the scientific term applied to a suspension of finely divided materials in air. Some common examples are smoke, fogs, clouds, or suspended dust. The finer these particles are, the longer they will stay suspended, but we soon found that a certain size range was best for insecticides.

There were several ways already described in the literature for the production of aerosols from materials similar to insecticides. One method consisted of partially burning a material and using the insecticide-laden smoke. An example is tobacco smoke. Another method employed heat to break the insecticide into fine particles. The army screening smoke generator is an example. This method is now being developed for the production of aerosols on a large scale. Mechanical methods were also available, some of which used a stream of air as in the common atomizer. All of these methods were studied but they lacked the convenience and other features that would make aerosols a practical improvement over sprays.

* An address by Dr. L. D. Goodhue, Senior Chemist, Bureau of Entomology and Plant Quarantine, Beltsville, Md., accepting the John Scott Award for his part in the development of insecticidal aerosols. His co-worker, Capt. W. N. Sullivan, on leave as Associate Entomologist of the same Bureau, received the same award. In accepting it, Capt. Sullivan spoke extemporaneously about the uses of the aerosol bomb in the Army.—ED.

Next the liquefied-gas method was conceived and tried. This new method was successful from the beginning. It consists essentially of dissolving the insecticide in a liquefied gas under pressure and allowing this solution to escape through a small orifice under its own pressure. The violent boiling of the liquefied gas disperses the insecticide in the form of a fog, or aerosol, which remains suspended and effective for long periods. The solution under pressure is conveniently contained in 1-pound bombs ready for instant use by simply pressing a button.

Photo by Philadelphia Inquirer

A JOHN SCOTT AWARD

CAPTAIN W. N. SULLIVAN AND DOCTOR L. D. GOODHUE RECEIVE JOHN SCOTT MEDALS FROM MR. WALTER B. GIBBONS, OF THE BOARD OF CITY TRUSTS, FOR THEIR DISCOVERY AND DEVELOPMENT OF INSECTICIDAL AEROSOLS AND THE AEROSOL BOMB, WHICH MR. GIBBONS HOLDS IN HIS HAND. ON THIS OCCASION IN THE ROOMS OF THE AMERICAN PHILOSOPHICAL SOCIETY ON SEPTEMBER 20, 1945, THEY ALSO RECEIVED SCROLLS AND CHECKS FOR $500 EACH.

The insecticide best adapted to this method of application is pyrethrum. The best suited liquefied gas is dichlorodifluoromethane (Freon-12), commonly used in household refrigerators. This material, combined with sesame oil to improve its properties, gives a superior insecticide that is convenient to use, is nontoxic to man, nonflammable, and yet highly toxic to many species of insects, especially mosquitoes.

The armed forces realized the advantages of this method when the war broke out and something was needed to fight mosquitoes, which carry malaria, yellow fever, dengue, filariasis, and other diseases. The method was adopted, and at the close of the war over 35,000,000 of these 1-pound aerosol bombs had been manufactured. They were used and acclaimed[1] in many parts of the world and no doubt afforded much comfort to the men and greatly reduced the incidence of insect-borne diseases.

DDT, the insecticide about which you have heard so much, was combined with pyrethrum in the aerosol bomb about a year ago. It increased the effectiveness of the aerosol, especially against flies. Research has increased the efficiency of the aerosol many times, and improvements are still being made.

Judging from the demand by the armed forces, this aerosol method of applying insecticides is expected to become popular for civilian use. Some companies have offered aerosol bombs for sale in a limited way as an acceptance test, and the results are good. A large number of firms are interested in the manufacture of aerosol bombs, and considerable industrial research is being directed toward making improvements in all phases of the work. In a short time the aerosol bomb will probably be a standard item for public use.

The liquefied-gas method of making aerosols has many other uses. It has been employed successfully for the control of some field-crop insects on a large scale. Here methyl chloride, which is too toxic for household aerosols, can be used as the propellent.

In closing I might say that other materials besides insecticides, such as germicides, fungicides, plant hormones, weed killers, medicines, perfumes, and many other materials, can be applied by this liquefied-gas aerosol method.

Again permit me to express my appreciation of the recognition of our work.

LYLE D. GOODHUE

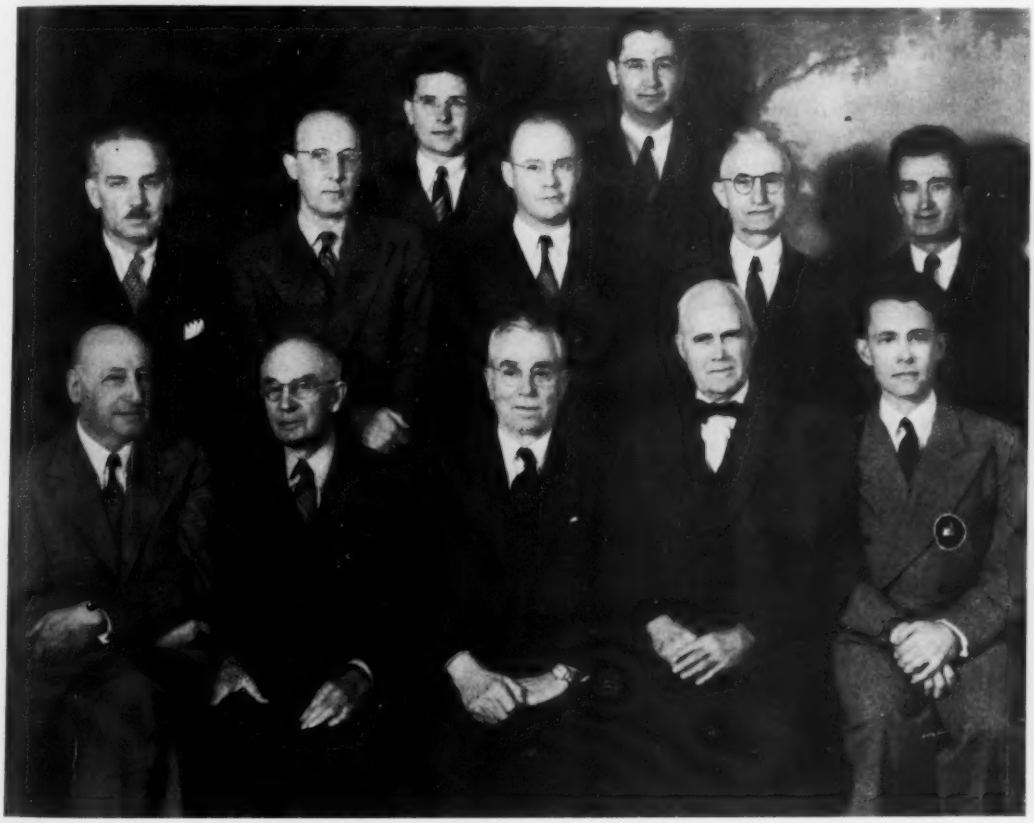
[1] For example, Sgt. Edward Wollerman on Luzon wrote to the editor: "If I return home without becoming ill with malaria, I can give a lot of credit to the convenience and protection of the aerosol bomb."

CHARLES ATWOOD KOFOID

OCTOBER eleventh was the eightieth anniversary of the birthday of Charles Atwood Kofoid. In appreciation of Professor Kofoid's career as a biologist and member of the faculty, the department of zoology at the University of California in Berkeley held a reception in his library. The reception was attended by many persons who as students or colleagues had been closely associated with him; and many letters expressing good will and congratulation were sent by friends who could not be present.

Professor Kofoid was an active member of the department of zoology during the greater part of the period of its development to the time of his retirement ten years ago. Although for twenty-four years Joseph Le Conte had given a series of two lectures a week throughout the academic year in comparative zoology, the growth of the department began in earnest when William Emerson Ritter came in 1892. He began to organize laboratory work in relation to Professor LeConte's lectures, and in the remaining years of the century there was continued expansion of both the curriculum and the staff. The building that was to house the department for more than thirty years, East Hall, was built in that period.

So it was to a relatively newly organized, freshly developing, and enthusiastic department that Professor Kofoid came at the beginning of 1901. In the first few years the part of the curriculum of which he was in charge included microscopical technique, em-



McCullagh, Berkeley

FACULTY IN ZOOLOGY, UNIVERSITY OF CALIFORNIA, BERKELEY

Front row, left to right: RICHARD GOLDSCHMIDT, S. J. HOLMES, CHARLES A. KOFOID, H. B. TORREY, HAROLD KIRBY. *Second row:* E. RAYMOND HALL (NOW AT THE UNIVERSITY OF KANSAS), J. E. GULLBERG, ALDEN H. MILLER, S. F. LIGHT, S. C. BROOKS. *Third row:* RAY L. WATTERSON, RICHARD M. EAKIN. TWO MEMBERS OF THE STAFF—J. A. LONG AND SETH B. BENSON—WERE ABSENT WHEN THIS PICTURE WAS TAKEN IN THE SPRING OF 1944.

bryology, cytology, and invertebrate zoology. By 1909, however, he had discontinued this work and had introduced courses in the biological examination of water, protozoology, and general parasitology. At this time, Professor Ritter transferred his residence to La Jolla, returning to Berkeley only for a few weeks of lectures each year, and Professor Kofoid became chairman of the department. He continued to be the administrative officer until his retirement in 1936, except for a short time following his service as major in the Sanitary Corps of the United States Army in 1918 and 1919. His influential position in departmental matters contributed greatly to university development; and he played a particularly important and freely acknowledged part in shaping the pattern of intellectual growth of many who have been active in biological and medical work beginning forty years ago. This has been especially true for the sixty graduate students who, between 1901 and 1940, received the Ph.D. degree from the University of California after completing thesis work with Professor Kofoid.

An important early contribution was his work in connection with the marine biological station that was at first closely related to the department. Before 1900 Professor Ritter and the other members of the faculty of the department had made efforts to establish a place for seaside work in marine biology. In 1901, these efforts became more continuous and fruitful, and interest developed in undertaking a detailed biological survey of the coast of California. Before long it was decided that it was desirable to specialize on the plankton and pelagic life of the nearby ocean. Eventually, a marine biological station became established at La Jolla.

While acting as special investigator for the U. S. Bureau of Education in 1908 and 1909, Professor Kofoid had made an extensive study of the marine and fresh-water biological stations of Europe. He published in 1910 a detailed and well-illustrated account of these laboratories. In acknowledging the contributions which had been made to the construction and equipment of the new laboratory built in 1910 on the pueblo tract near La Jolla, Professor Ritter wrote that "into the general working plans of the station are woven the suggestions, the ideas, and the activities of Professor C. A. Kofoid and H. B. Torrey in so intimate a way that surely without them the institution could not have been exactly what it is."

Also in that period, besides his biological studies, Professor Kofoid made two outstanding contributions to plankton investigation. One of these was his invention of a self-closing water bucket which made it possible to obtain from a known level twenty liters of water for filtration and analysis. The other was the self-closing plankton net which he devised. This net, weighing about 180 pounds, could be lowered to a desired level while closed, opened and towed at that level, then closed before drawing up.

Professor Kofoid was assistant director of the Marine Biological Station of San Diego, and of the Scripps Institution for Biological Research as it was later called, until a short time before Professor Ritter retired as director. In 1925 the laboratory was organized, without further direct relation to the department of zoology, as the Scripps Institution of Oceanography.

Professor Kofoid's name has been associated especially with protozoology, but biological subjects of many sorts have entered into his interests in teaching and research, writing and lecturing. At Harvard University, before he took his degree in 1894, he studied the origin and history of the mesoderm, cleavage, and cell lineage in *Limax*. In the five and one-half years before he came to California, when he was superintendant of the Illinois Biological Station, he carried on a study of the plankton of the Illinois river, the scope of which he defined as "a continuous, systematic and exhaustive examination of the plant and animal life suspended in the waters of a river system with a view to determining its amount and seasonal changes, its local and vertical distribution, its movement and relation to the current, the effects upon it of flood and drought, of light and temperature, the organisms which compose it, their seasonal and cyclic changes, and their mutual interrelations. Added interest arises from the fact that this is the first application of this method of biological investigation to a river system and its related waters."

Removal to the coast of California was fol-

lowed by a shift of his studies to marine plankton, and the Alexander Agassiz expedition to the eastern tropical Pacific soon provided an opportunity to extend his investigations beyond the coastal waters. From the Albatross in 1904–05 he made extensive collections of plankton, and from these he subsequently made elaborate studies of dinoflagellates and tintinnids—studies aided for a number of years by Agassiz himself. He carried on research on marine plankton while he occupied the Smithsonian Institution table at the Naples Biological Station in 1908, and at the Asamushi Marine Biological Station in Japan in 1930, when the Rockefeller Foundation appointed him to a visiting professorship at the Tôhoku Imperial University in Sendai. On trips across the Pacific he took advantage of the opportunity for filtering plankton from the running sea-water system of the steamship—an indication of his enthusiasm for this work.

Professor Kofoid's service in the Sanitary Corps in 1918 and 1919 marked the beginning of a series of studies of parasites of man, resulting particularly in detailed and finely illustrated papers on the intestinal flagellates and amoebae. This group of studies culminated in the late twenties in cooperative work in the Stomatological Research Group of the University of California, in which Professor Kofoid and his associates made extensive studies of the protozoa of the human mouth. For some years following his army experience, he directed work in the parasitological division of the Bureau of Communicable Diseases, California State Board of Health; later until about the time of his retirement he conducted a laboratory for parasitological examinations. An important feature of this laboratory was the technical training of students working in it, and the upholding of standards of accuracy and thoroughness that had a valuable influence on the training of medical technicians in the state. When in 1923 he gave the Faculty Research Lecture, selection for which is regarded as the highest honor the Academic Senate of the University of California can give to one of its members, he chose the topic "Amoeba and Man."

In 1921 the staff of the proposed Bombay School of Tropical Medicine was being selected, and two professorships—one in clinical medicine and one in protozoology—were to be supported by donations from Sir Dorab Tata. It was hoped that the best men available for teaching and research in their subjects could be attracted to the new institution. Professor Kofoid was nominated to the Tata Professorship in Protozoology by the Tropical Diseases Committee of the Royal Society of London, and was appointed by the Bombay Government; but because of uncertainty about the organization of the School and desire to maintain the continuity of his research projects he resigned the appointment without leaving Berkeley.

As would be expected of a biologist, Professor Kofoid's interests in medical protozoology gave equal weight to all aspects of the problems; biological, medical, and public health matters shared his attention without unbalanced consideration of any one alone. His Faculty Research lecture expressed his point of view: "Progress in the applications of science in any field is in the long run safely and soundly made only upon the basis of some accurate knowledge of many factors basic and collateral to the subject. . . . In this realm of science no subdivisions into pure and impure, useless or applied, can exist for the discoverer."

In 1914 shipworms appeared at the north end of San Francisco Bay in a region from which it had been thought that they were excluded by fresh water entering by the Sacramento river. After 1917 damage became severe, and in 1920 a committee was appointed to study the problem, combining the interests of the American Wood-Preservers' Association and the Forest Products Laboratory. Professor Kofoid, who had for some years before been concerned with the problems of marine borers in California harbors, became chairman of the subcommittee on biological research. Members of the committee requested the National Research Council to organize a marine borer study on a wider scale, and in 1922 a council committee on marine piling investigations was appointed including Professor Kofoid as biologist. Work for both these groups was carried on by him and biologists who became associated with him at the University of California. The final reports of the work of the two groups which were published in 1924 and

1927 included a consideration of all phases of the biology of the marine borers.

Shortly after the appearance of the final report of the San Francisco Bay Marine Piling Committee, interest was stimulated in damage by termites to wooden structures on land. The destructive *Coptotermes* had been found in the wood of an ocean liner docked in San Francisco, and it was feared that it might become established in California; also there was increase in attention to damage by native termites. The cooperation of the University was sought in study under a committee which consisted in part of the same personnel as in the Teredo-group. Biological work was carried on in the department of zoology under the direction of Professor Kofoid and Professor S. F. Light, and a final report in which again all phases of the biology of termites were considered appeared as a book in 1934.

These investigations, in which biological and economic considerations were combined, interested Professor Kofoid greatly, and his enthusiasm and ability played a decisive part in carrying them on. He conducted also, in cooperation with associates and students, studies of various groups of protozoa besides those of marine and fresh-water plankton. Among these, were the striking associations of protozoa in termites; those in ruminants and the elephant, from which he secured material in 1915 and 1916 in Ceylon and India; and those in molluscs in the littoral zone. In these, and in various free-living protozoa, he was interested particularly in the structural basis for coordinated activity, designated the neuromotor system; in questions of colonial or multiple organization and individuality; and in the significance to evolutionary considerations of these situations in which the factor of natural selection did not seem to be playing a primary rôle.

From the beginning of his career Professor Kofoid has been a bibliophile, and has gathered a very large and valuable library, of books and reprints, in which the history of science, protozoology, and parasitology are particularly well represented. Mrs. Kofoid, who died in 1942, worked with him for many years in the organization of this collection, and the University of California Library has provided space to accommodate it.

In the year when Professor Kofoid came to California he began to conduct a section designated Current Zoölogical Literature in the *Journal of Applied Microscopy*, which was published by the Bausch and Lomb Optical Company. He made the abstracts and reviews that were given, until the journal was discontinued in 1903. He has continued this sort of work with scientific literature ever since, and has prepared many hundreds of reviews and abstracts for publication. From the beginning of *Biological Abstracts* to the present he has been editor of the Section on General Biology, for animals; and from 1931 he has been associate editor of *Isis*, responsible for reviews of historical literature in biology and zoology.

A large part of the research done in the department has been published in the University of California Publications in Zoology, which began in 1902 and now consists of more than fifty volumes. At first the series was edited by Professor Ritter; from the end of 1909 until his retirement Professor Kofoid was one of the editors, and he upheld standards of excellence in composition and illustration which have been characteristic of his own publications. He has also, at one time or another, been associate editor of a number of scientific journals here and abroad.

Professor Kofoid's attainments have been recognized by his election to various organizations related to his subjects; by appointment at times to the councils and as presiding officer of some of these; by his election to the National Academy of Sciences in 1922; and in many other ways. Honorary degrees have been conferred on him by Oberlin, where he finished his undergraduate work in 1890; by the University of Wales; and by the University of California. At the 74th commencement in 1937, when President Sproul presented him with an honorary LL.D., he characterized him as "A humane scientist, distinguished alike for the breadth and depth of his knowledge of zoology and its contributions to the science of medicine and public health; an effective teacher who embodies eminence in the field of science and devotion to the spiritual life; one who places scientific knowledge at the service of mankind."

HAROLD KIRBY

COMMENTS AND CRITICISMS

Prometric

It has occurred to me that THE SCIENTIFIC MONTHLY might render a service to its subscribers not resident in English-speaking countries, and in general to all, in paying more attention to the use of metric measures in the articles presented.

As an example, the interesting story beginning in the July 1945 issue, The Problem of the Amazon, which is a translation from the original in Portuguese, converts most of the metric units—doubtless used in original article—into the English. The story will doubtless be widely useful, not only in this country but abroad, the translator stating that the original edition was very small. If, as you may consider necessary, the English units—such as miles and degrees Fahrenheit—must be used in such a story, the metric could readily be placed in parentheses. In this same July number there is one example of introduction of metric equivalents in a chart on page 47.

Personally, I hope this country may eventually convert to the metric system; it is believed that this could be done over a reasonable period without serious embarrassment, and with great benefit to all concerned. In any event, if the English-speaking nations are to remain on an island in this respect—using a system of weights and measures differing from that of the rest of the world, a broad point of view should at least give recognition to the wide use of the metric, inserting metric equivalents of important quantities.

It is of course common in scientific practice and in a number of other ways, even in this country and England, to utilize the convenient metric system. I feel therefore that your periodical would be doing a service in giving some recognition to that important system.—LOUIS ELLIOTT.

Antimetric

As to the editorial policy for the MONTHLY, with reference to use of both English and metric system units, you have really a difficult problem. So have we. I have grappled with it without much consistency, I fear.

In general, I think that for a journal such as THE SCIENTIFIC MONTHLY, I would be rather inclined to take the easy course of printing units in whichever system the author of the paper employed and making no attempt in general to translate the units from the one system to the other.

The reason is essentially this. Some of your manuscripts will pertain to laboratory researches. You may perhaps have a paper on the atomic bomb in which some of the dimensions have been given in micrograms. If you have papers in immunology or endocrinology, micrograms or milliliters would have been employed. To translate these into units of the English system would be relatively meaningless. Moreover, if a man mentions an object whose dimensions are, say, 5 centimeters by 2 centimeters by 3 centimeters, the simple digits will suffice to give the number of centimeters but when you translate this into inches, fairly long decimals will have to be employed.

In other fields, as for example ecology, measurements may be given in yards or pounds. These are meaningful for most of the readers of the MONTHLY, whereas the giving of equivalents in meters or kilograms would not be any significant addition to the comprehension of the paper. It would be just an operation for editorial consistency which, in my way of thinking, would hardly yield returns commensurate with efforts to be applied.

If a geographical paper in Brazil gives the length of a river in kilometers, well and good, I would be inclined to leave it in kilometers. If a similar geographical paper in the United States gives a distance from one city to another in miles, I would not translate it to kilometers, or even indicate the number of kilometers in parenthesis.

What I am getting at is the different fields of research and their own accustomed units of measurement. Those who are interested in seeing the measurements expressed in the other system, are as a rule the people who have the equivalents, or the factors for multiplication, pretty well in mind.

Part of my reaction here is due to the fact that I am not one of those who would like to see the metric system supersede the English system in general.—JOHN E. FLYNN.

Because space was lacking, the three remaining paragraphs of this letter had to be omitted. Dr. Flynn went on to say that the metric system is not so advantageous as it was when originally proposed because of the growth of the English-speaking world since that time. He concedes the superiority of the metric system in the laboratory but contends that for practical purposes the duodecimal units of the English system (easily divisible by two, three, and four) are advantageous. "It is unfortunate," he says, "that we do not have six fingers on each hand instead of five. If we had been so equipped, division would have been much easier." Professor Ore comments on "the dozen system" on page 373.—ED.

THE BROWNSTONE TOWER

On July 12 of this year we received from Mr. Louis Elliott, Consulting Mechanical Engineer, a letter (see page 419) advocating more extensive use of the metric system in The Scientific Monthly. Our first impulse was to abandon English units — why should The *Scientific* Monthly help to perpetuate an *unscientific* system of weights and measures? Then we turned to our editorial adviser, Dr. John E. Flynn, Editor-in-Chief of *Biological Abstracts*. As usual, Dr. Flynn gave us the full benefit of his experience in a carefully considered letter (see page 419). He advised us to publish measurements in the system preferred by the author without adding in parentheses equivalent figures in the other system. We were highly susceptible to this advice at the time it was received, for our assistant, Mrs. E. B. Scovill, was absent because of illness. We could not, and still cannot, undertake anything that involves additional editorial work. Unlike Dr. Flynn, we should like to see the metric system supersede the traditional conglomeration of weights and measures called "English." Our reasons for desiring this change are not theoretical but practical and immediate: we must now instruct our engraver in inches and our printer in picas, whereas we actually make all our editorial measurements in centimeters, as any scientist would do. Professor Ore, writing on the metric system in this issue (pages 373–375), predicts that the universal use of the metric system "will be viewed with considerable favor by the world organization which will eventually be created to further international cooperation and coordination." In making that prediction the professor has carefully retracted his neck, but, to use professorial language, it is not improbable that he is not averse to the universal adoption of the metric system. And he knows that it will take a long time to bring it about. So we say to Mr. Elliott, "Be of good cheer—The Scientific Monthly teeters toward you." When we get an editorial assistant, we may give roughly the metric equivalents of English units for the benefit of our Latin-American readers. In the meantime we urge everyone who favors the metric system to use it exclusively in contributions to The Scientific Monthly.

We have been wondering what arguments would be most likely to induce scientists and friends of science to contribute to our centennial building fund. Why, indeed, should a member of the A.A.A.S. part with more than his annual dues? He can easily demonstrate that he has no unallotted balance at any time, and that he is insolvent at the end of each month. If he is married—most scientists are in that happy state—there are a thousand reasons why he thinks he cannot contribute: like Mrs. Day, mother may not be able to keep a budget and the money just disappears; or the children must have new clothes; or the house needs repairs (was there ever a home-owner who could not sink a fortune in his house?); or relatives need assistance; or a new car is absolutely necessary, and so on and on. Yesterday we shook hands with a scientist who may have money to spare, but so far as we know he is unique. *You* have no money to spare, but you *can* contribute to the building fund. When you were out of cigarettes, did you buy more, if you could get them? When you wanted to see a certain movie, did you go? When you needed gasoline for that long-deferred vacation, did you purchase it? We will not ask questions that might be more embarrassing. The general answer is, of course, that you spend without hesitation whatever small sums seem essential to promote the private welfare. And small sums add up to larger sums until, as Hi Ho has demonstrated by simple arithmetic, you could retire, or something, if you could only stop the little leaks in the pocketbook. If the very thought of pinching pennies is obnoxious to you, forget it and indulge yourself in your accustomed manner. We ask only that you include the centennial building fund among your list of indulgences for which you pay as a matter of course without counting the cost until later.

"But why," you say, "should I leap to my checkbook because the A.A.A.S. needs a home of its own? Why not let Ajax carry the load?" Why not? Because the new building is to be *your* home as well as ours. It will stand before the public as a monument to your faith and pride in the importance and dignity of your profession as a scientist. Let nothing prevent you from having a hand in it.—F. L. Campbell.